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CONTENTS

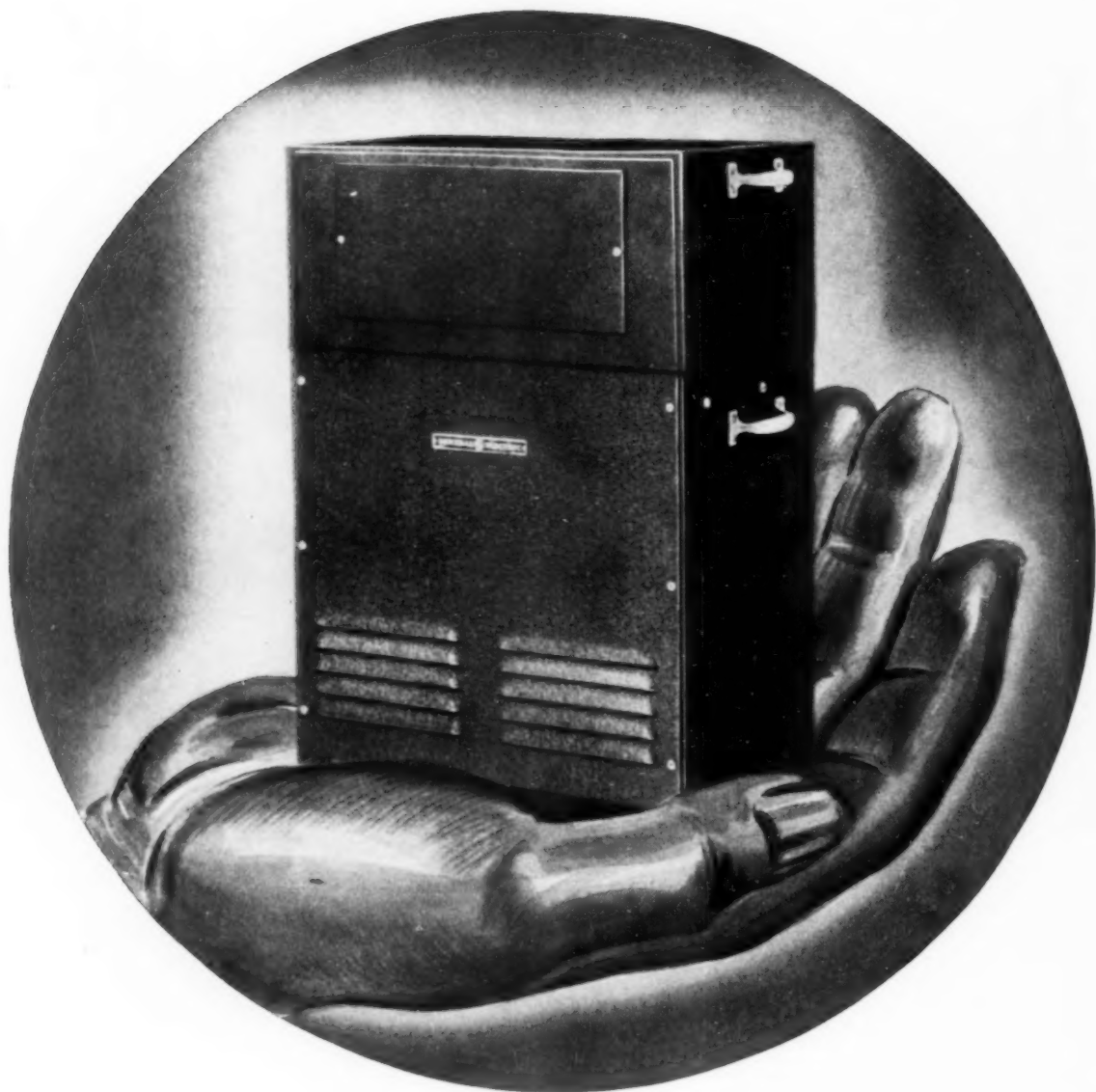
Editorial	423
The Selenium Rectifier for Electroplating—By Joseph B. Kushner	424
Polishing and Its Phases—By Joseph G. Sterling	427
The Influence of Organic Compounds in Nickel Plating Solutions — By Ernst Raub and Max Wittum	429
Electrolytic Metallizing on Non-Metallic Surfaces—By Elias Schore	433
Meeting of A.S.T.M.	438

Organic Finishing Section 459-474

DEPARTMENTS

Shop Problems	442
Electroplating Digest	443
Post Scripts	444
New Equipment and Supplies	446
Manufacturers' Literature	449
New Books	450
Associations and Societies	451
Letters	451
Obituaries	453
Personals	454
Business Items	456
Supply Prices	458

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Industrial Arts Index.



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GENERAL  **ELECTRIC**

Tin A Strategic Metal

The control of the East Indies by Japan would be a serious blow to the United States from the angle of strategic materials, such as rubber and tin. Out of a world production of about 150,000 tons of tin in 1938, only 150 tons were produced in the United States, and the total production of tin in both North and South America was not much more than 25,000 tons or about 17% of the world's production. Unfortunately, over 60% of the world's production of tin emanates in the Far East, with the largest production from the Malay States. Forty-three thousand tons of tin were mined in the Malay States in 1938; 21,000 tons from Netherlands, India; 13,000 from Siam and 11,000 from China.

The mining of tin in the Far East has been able to keep pace with the demand. The largest producer of tin in the Americas is Bolivia, which, even in boom times, was only able to produce about 46,000 tons, which would represent about only half the tin required by the U. S. for consumption. Although the United States produces practically no tin, we consume over one-third of the world's production.

Our status in regard to rubber is about the same as that of tin, although the development of various synthetic rubbers may enable us, in a few years, to become self-sufficient, although at a great increase in cost.

It is obvious, therefore, that a change in the status quo in the East Indies would be of serious import to us.

Neutral Soap

The expression "neutral" soap is rather widely used to designate pure soap without the addition of builders, such as sodium carbonate or silicate. The expression is unfortunate as it does not represent the true condition of soap. Chemically, soaps are salts of weak, high molecular weight fatty acids and chemically strong alkaline metals. A solution of any soluble salt composed of a weak acid and strong

base (sodium or potassium hydroxide) hydrolyzes to give a basic or alkaline reaction. This is an immutable phenomenon, and therefore, any true soap will react alkaline in spite of claims of purity or testimonials from movie stars.

Solutions of "neutral" or pure soaps will have alkalinities from pH 9.5 to 10.5, whereas a pH of 7 is neutral.

Many of the newer wetting agents are strictly neutral or may even be acidic but they are not soaps according to the proper definition.

Cleaning Zinc Base Die Castings

Studies recently published by F. Oplinger, B. F. Lewis and Anderson and Reinhard, on cleaning of zinc base die castings previous to plating point definitely to important factors contributing to blistering of the deposits. These factors are overcleaning and overacid dipping.

It was shown that cleaning, for even short periods of two minutes, may sufficiently attack the zinc alloy to etch the surface resulting in subsequent blistering of the plate. Likewise, the usual acid dip of 5% hydrochloric acid was found to be too strong and a 30-40 second dip in 1% acid was found to be more satisfactory. The poor adhesion from overcleaning or acid dipping may be due to several factors. The most obvious factor is a marked increase in the apparent diffusion rate between the copper plate and the zinc alloy resulting in the formation of brittle alloys. Another factor is the formation of a non-adherent smut from preferential solution of various components of the alloys. Thus, copper may not be dissolved in preference to zinc. Still another factor is the increase of surface area by etching, contributing to more rapid diffusion.

These observations should lead to:

1. A wider use of precleaning methods, such as hot solvent or vapor degreasing, solvent washing or emulsifiable solvent cleaning.
2. Development of alkaline cleaners with slight attack on zinc.

The Selenium Rectifier for Electroplating

By Joseph B. Kushner, Ch. E.

*Personalized Plating Service
New York*

The construction, power limitations and efficiency of the selenium rectifier are described. The rectifiers have high current capacity per unit of plate area and relatively uniform efficiency over wide loads. Comparisons between motor generators and the selenium rectifier are given.—Ed.

Just twenty years ago, Grondahl made the first practical dry type rectifier¹ capable of carrying currents sufficiently heavy to be used for electrodeposition. Since that time, particularly in the last decade, improvements have been made in his original rectifier, the copper oxide barrier layer cell, and newer types of dry rectifiers have made their appearance. Among these new types is the selenium rectifier, a rectifier suited for electroplating purposes.

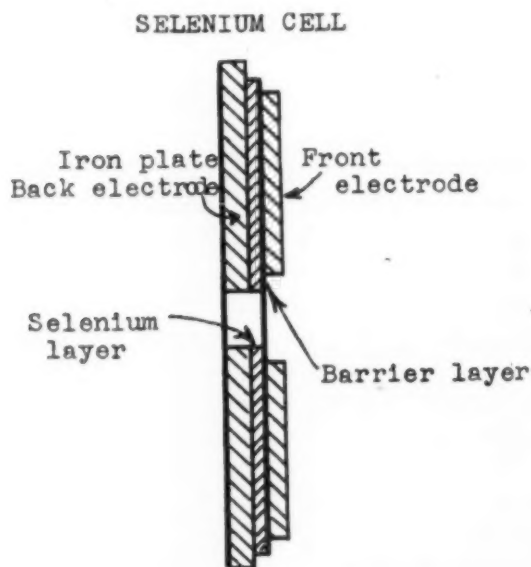


Fig. 1. Diagram of selenium cell.

The selenium rectifier, in common with the other dry or barrier layer rectifiers, operates on the principle of a crystal detector. It offers little resistance to the flow of current in a forward direction and high resistance to current flow in the reverse direction. The area of contact defined by the familiar "cat's whisker" of the crystal detector is multiplied many times in the selenium cell so that currents of high amperage can be passed instead of the microamperes of a radio circuit.

1. L. O. Grondahl, *Trans. Electrochem. Soc.*, 72, p. 225, (1937).

Construction

The construction of the typical selenium rectifier disc is quite simple. First, a layer of selenium, a relatively rare photoelectric element, is placed on a roughened iron disc called the back electrode. The layer of selenium is made only 0.05 millimeters thick in order to reduce internal losses to an absolute minimum. Second, the selenium is converted to metallic form by a heat treatment. Third, a layer of soft metal alloy is placed over the selenium. This is called the front electrode.

If the front electrode is made cathodic in an electrical circuit, a measurable amount of current will flow from the selenium to the front electrode; if the polarity is reversed, very little current will flow at all. The ratio of this forward current to the reverse current is called the rectification ratio and is a good rectification yardstick. The curve of this function, as it varies with the applied voltage, indicates that this ratio approaches a maximum at three volts. Under actual operating conditions, due to the fact that higher voltage differences exist, because of the drop of potential in the load, the average rectification ratio obtained is about 50 to 1.



Fig. 2. Small plating rectifier unit.

Power Limitations

The amount of power that can be handled by a selenium rectifier disc is limited only by two things: (1) Voltage breakdown; (2) Temperature rise. The maximum voltage in the reverse direction that can be applied to a selenium cell is about 18 volts; the breakdown or sparking voltage is somewhat higher so that there is a safe margin for variations in the line voltage. This high reverse voltage permits the use of fewer cells to obtain a given current.

High Temperature Operation

The temperature rise under operating conditions is an important criterion when it comes to electroplating where large currents are used continuously. The selenium cell can operate at ambient (surrounding) temperatures up to 35° C. (95° F.) with an allowable temperature rise of 40° C. This makes the maximum limiting operating temperature 75° C. (167° F.). Since the permissible ambient temperature is relatively high, the selenium rectifier can be operated successfully with natural ventilation, no forced cooling being necessary. At normal operating temperatures, one square centimeter of rectifier surface can carry about 50 milliamperes of current but if provision is made for increased ventilation, considerably more current (up to 180 milliamps) can be safely carried. To carry heavier currents, ventilation of the selenium rectifier is improved by: (1) Increasing the spacing between the discs; (2) Adding cooling fins; (3) Designing the housing for chimney draft ventilation; (4) Adding a cooling fan.

The fact that the permissible current density is limited only by operating temperature makes it possible to greatly overload the selenium rectifier for short periods of time without any damage occurring. This is a distinct advantage in plating operations such as cleaning and flashing where an unusually large piece of work may temporarily draw high currents.

Light Assembly Pressures

In assembly, the selenium rectifier requires only light pressure for contact purposes. This is a marked superiority over other types of cell which require very heavy pressure for contact. No heavy hardware, bolts or screws are required for mounting. Weight is kept down to a minimum.

The combination of high back voltage and current carrying capacity with low pressure contact requirements, makes the selenium rectifier considerably lighter in weight and smaller in size than many other types of rectifiers. For example, on a weight basis, the selenium rectifier is about one sixteenth the weight of another popular type of dry rectifier delivering the same power.

Efficiency

The electrical efficiency of the selenium rectifier is quite high, varying from about 85% on a three phase circuit to about 65% on a single phase circuit. This high efficiency is maintained almost uniformly from about 20% to 140% full load. This can be seen from a study of the accompanying efficiency curve. This is an outstanding advantage of the selenium rectifier over the motor generator in the plating shop where there are intermittent



Fig. 3. Small plating rectifier used in an experimental set-up.

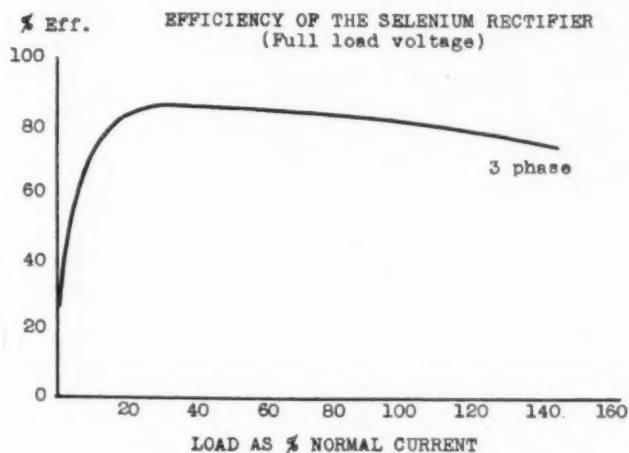


Fig. 4. Curve illustrating the efficiency of the selenium rectifier operated at various loads.

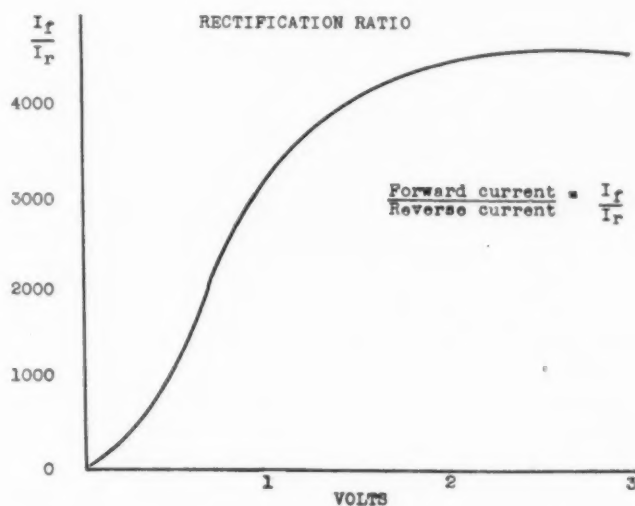


Fig. 5. Rectification ratio of selenium rectifier.



Fig. 6. Seven-volt, 200 ampere rectifying unit for commercial plating.
(Courtesy W. Green Electric Co., New York)

or fluctuating loads. In most job shops and manufacturer's plating rooms, there are many periods during the day when some of the tanks stand idle or varying loads are placed on the line. The selenium rectifier, under these conditions operates to far better advantage than the motor generator as the efficiency of the motor generator drops drastically below 50-60% loading. This means a distinct saving in yearly power cost to the plater.

Another phase to be considered is idle running cost. When the motor generator runs idle between loads, the cost to run it is much higher than the cost of running a rectifier on no load. The generator's fixed losses, bearing and brush friction, are much higher than those of the selenium rectifier which has no moving parts. Incidentally, the selenium rectifier can be economically shut off during short rest periods whereas a generator cannot. This is due to the fact that the generator may require as much as half an hour to come to proper operating condi-

tions while the rectifier on being turned on, assumes proper voltage instantaneously. Again, in starting a motor generator, excess power is needed to turn the machine over; with the rectifier no excess power is needed and the proper current is obtained almost at once. All these factors point to one thing: *lower yearly power cost* is obtainable with a rectifier such as the selenium rectifier in all plating applications where varying loads are placed on the line during the course of a working day.

Power Factor and Regulation

The power factor of the selenium cell is approximately unity. The voltage regulation is particularly good, in the order of about 15% for resistance loads. The average motor generator has a regulation no better than this. If better regulation is desired, a compounding or primary switching arrangement can be resorted to.

Life

The selenium rectifier has a practically unlimited life. At some time during the first 10,000 hours (5 work years) of use, the forward resistance of the selenium cell increases by about 5% or less. This results in a very slight drop in the output voltage. This can be corrected for by a 5% tap on the transformer. After the first 10,000 hours of use, no further voltage drop takes place and from this time on the voltage remains constant.

Installation

The cost of installing a rectifier such as the selenium rectifier is low as compared with the cost of installing an equivalent motor generator set. The lightness and compactness of the selenium rectifier permit its installation in simple metal cabinets; the motor generator should have a level foundation to operate properly. Again, there are no moving parts in the rectifier, whereas the generator's moving parts require constant care and upkeep.

The qualities of the selenium rectifier for electroplating which have been appreciated for the past five years in England, Switzerland and Germany are now first being recognized here in America. It is fairly safe to say that the coming years will manifest a greater use of the selenium rectifier in the plating shops of the U. S.

Acknowledgment

The writer wishes to thank Mr. Reinken, engineer of the International Telephone Development Co. and Mr. H. Einstein, of the Green Electric Co., for their cooperation in the preparation of this paper.

The Eastman Kodak Co. is the country's largest single user of silver. Only the United States Mint outranks Kodak as a user of silver. The great photographic company uses 6,000,000 ozs. annually for photographic films. Each week Kodak dissolves four tons of silver in nitric acid for the production of silver nitrate.

The oldest chartered industrial concern in the world is the copper mine at Falun, in Dalicarlia, one of Sweden's most picturesque regions for travelers. The mine has been under the same continuous ownership since 1220 and so much has been taken from it, that its excavations would hold the Cheops Pyramid.

When the New World was discovered, the inhabitants of many parts used gold not only for articles of adornment but for many common purposes. In Brazil and Mexico, the natives used fish hooks fashioned of gold, and on the arrival of their conquerors were glad to exchange hooks of gold for others made of iron.

Polishing and Its Phases

By Joseph G. Sterling

*General Electric Co.
Bridgeport, Conn.*



Joseph G. Sterling

Better appearing plates require good preparation of the base metal either by polishing or by mill work. In addition, recent research indicates that nickel deposits on well polished steel are less porous than those of equal thickness on poorly polished steel. Some observations and data on setting up polishing wheels and sequences of polishing are given.—Ed.

The present demand for high grade finishes on plated articles requires good basic structure of materials to be used. The uniformity of the finish is necessary in the polishing, plating and buffing operations, if successful results are the object. The first step in producing a finish for plating, which requires a high lustre, is to polish the piece or article to a smooth fine surface. Polishing is the method or process of removing material of any part or object to the desired finish by means of polishing wheels which have abrasives secured entirely by glue or cements and are set in polishing lathes, driven at speeds best suited for the part or job, the objective being the smoothing out the surface intended or required. It requires time and money to polish and it is the proper grain, binder and wheel, plus the experience of the polisher that will put a higher and more uniform polish on parts requiring a surface which gives for good plating and buffing finishes. Narrow places, angles, and any places in which it is difficult to get a polishing wheel are bound to be poorly finished and will ruin the appearance of the part or

article. In most cases, the polishing compounds become packed and difficulties arise in the subsequent cleaning and plating operations. Wherever and whenever it is possible to design parts which are to be polished, plated and buffed, the engineers should always keep in mind the design to simplify difficulties which may be encountered in these operations.

Good Quality Requires Good Polishing

The quality of finish is of vital importance when polishing steel, not only because of the appearance of the product itself, but because a surface with even minute pits or flaws tends to pick up impurities that will corrode and discolor the steel. We do know that polishing does oxidize the surface of the metal, particularly when a roughing operation is performed, where the action of the abrasive on the part being polished is of considerable violence and pressure, resulting in blue colored spots from the heat, and will hold this color after cooling.

Polishing Operations

In the metal finishing industries, the polishing operations are more or less described as "roughing", "dry fining", "greasing" and "grease-finishing", with most of the firms or plants determining their own standards in accordance with the product they manufacture. I do know that some of these standards could be improved on and any number of articles picked up for inspection before purchase, will supplement my statement to that end. Many factors enter into the process of polishing, one of which, the characteristic of the metal, is of the utmost importance. The condition of the metal is the governing factor as to what polishing operations are required to obtain the desired finish. Much time and money can be saved if the polishing foreman would investigate the finish desired and polish accordingly.

Setting Up Wheels

All polishing wheels used must be balanced and filled snug on a machine spindle in order that the wheel will run smoothly, easily and true. The polishing machines should be kept in good order and have no loose bearings. In setting up wheels, the glue should be thinner in proportion to the fineness of the grain or abrasive used. The following table gives the glue concentrations recommended for various grit sizes.

Size Grit	% Dry Glue in Solution
30	50
36	45
46	40
60	35
80	33
100-120	30
150-240	25

For the small plant, two pots with 33% and 50% glue, or three pots with 25%, 35% and 50% glue solutions are usually quite satisfactory.

In our company we preheat the wheels and grain before applying the glue. The glue is kept at 150° F. and a thermometer is constantly with the equipment. We have an expert polisher who has been transferred to the job of setting up wheels. He can make up new wheels into desired shape and form to fit our automatic polishing machines. There are many types of wheels used such as, sewed canvas, hard canvas, sewed buff, felt, sheepskin leather, bullneck, walrus hide and wood block wheels. There are no jobs that I can think of which could not be finished if the above wheels are available. The grain used in the polishing wheels should be tough, strong, long lasting and durable. It should be a grain that packs closely and easily on the wheel and holds strongly to the glue. It should be a selected grade of ore, accurately graded, clean and a grain that is uniform in shape, size and grain surface.

Mention should be made here of the importance of keeping polishing wheels in good condition. In applying the abrasive to the wheel, the glue should be spread evenly and rubbed well into the surface of the wheel. The troughs where the abrasives or grains are kept should be sufficiently long to rotate a wheel in its circumference to prevent a non-uniform head of abrasive which otherwise would be produced. We try at all times to allow 48 to 72 hours for which time the wheels are allowed to dry before we attempt to use them again.

The chucks used on the automatic polishing machines should be made to hold the pieces firmly and the wheels should be shaped to fit the article to be polished. The wheels should be mounted on the spindle in the same direction of rotation that was made in the truing and set up of the wheel. The cracking of the polishing wheel should be done with a round pipe before being placed on the spindle of the polishing machine, and not on the spindle.

Polishing Operations

Operation	Grain Numbers
Roughing coarse wheel	20 to 80
Dry fining wheel	80 to 120
Greasing wheel	120 to 180
Grease finishing wheel	180 to 280

In polishing our fan bases for electric fans, we use No. 80 and No. 150 emery for paint finish, but continue with No. 180 to No. 200 and No. 240 emery when a high class chrome job is required. These bases are made of hot rolled steel, drawn into shape in the punch press department, hardened at tip of base and polished by hand using a holder with No. 80 and No. 150 dry wheels for a paint job. We can do these faster by hand than by an automatic machine. On the other hand, when a chrome

job is required, we continue with No. 180-No. 200 and No. 240 grease finishing and we do get a high class job from it. We find tallow and emery cake necessary in our polishing work on steel.

In polishing of zinc base die castings we find it very easy to use No. 150 to No. 180 emery in but one operation for preparation for painting. When these are required for chrome finish, we use No. 150 and No. 200 and cut-down buff and color.

High Finish Steel

But all of our steel that we use is not hot rolled steel, and in fact, our company buys some of the best steel obtainable which is our No. 3 grade steel. This steel comes to us from the steel mills in polished form between layers of heavy oiled paper. The Engineering Department states on the drawings what type of steel is used and we govern ourselves accordingly. If, however, difficulties arise, we in the manufacturing department get together with the engineers and eliminate the obstacles. The operators and inspectors in our punch press department are trained to the hazards caused by rough handling, scratching and damaging of the steel parts which eventually are plated and buffed. They know that the scratching and die marking are detrimental and cause extra work in polishing, involving extra expense.

We find that by using No. 3 steel wherever possible, we eliminate quite a bit of polishing. As a comparison, let us have one part from No. 3 finish steel and one from the hot rolled steel. The part from No. 3 steel required no polishing, but the one from hot rolled steel did. When we got these plated, buffed and chrome plated, we found the one from No. 3 steel better looking and cost us considerably less than the one from the hot rolled steel. Therefore, the idea that it is cheaper to buy hot rolled steel, polish and plate it than the better grade steel, does not hold good here.

We do know that the steel industries sometimes frown when asked to produce high lustre polished steels. But the only way to get it is to have steel users of high grade steels insist on getting better and brighter steels. We find that in forming operations the No. 3 steel structure is sometimes stressed. Then we apply a No. 200 or No. 220 grease operation which prepares these parts for plating.

Dies in the press department should be carefully watched to prevent die marking of steel parts. There are many ways in which time and money can be saved, and polishing of metals is one of them.

Our company does a wide and diversified line of manufactured goods which are as follows:

Toasters	Ironers	Ranges
Waffle Irons	Washing Machines	Hot Water Heaters
Sandwich Grilles	Radios	Curlers
Mixers	Electric Clocks	Dish Washers
Heaters	Irons	Percolators and Sets
Fans	Vacuum Cleaners	Electrical Goods
Sun Lamps	Refrigerators	

In looking over these items of manufacture, we do know that the operations of polishing, plating and buffing, play a big part in the appearance and cost of the articles produced.

The Influence of Organic Compounds In Nickel Plating Solutions*

PART III—CONCLUSION

By Ernst Raub and Max Wittum

This is the concluding part of this excellent study of the effects of organic addition agents on nickel deposits. Part I appeared in the April, 1940 issue of Metal Industry and Part II in the June, 1940 issue of Metal Finishing. In this concluding section, aromatic and heterocyclic compounds are studied. The article concludes with an evaluation of the results obtained.—Ed.

The polarization of nickel deposition is strongly increased by naphthol as Fig. 10, curves 2 and 3, for baths with 0.04 and 0.1 g/l α naphthol, show. Among the aromatic ketones, benzophenone and a few complicated compounds, such as camphor, morin and eugenol were investigated. These compounds contain in part, several keto groups and in addition, oxide groups as well as side chains. Their solubility in nickel baths is, for the most part, small. In the limits investigated, they were without distinct influence.

Aromatic Acids

Benzoic acid, salicylic acid, acetylsalicylic acid, phthalic acid, phenolphthalein, tannin.

Benzoic and salicylic acids have no distinct effect on the brightness of nickel. Acetylsalicylic acid, however, in additions from 0.1-0.2 g/l produces milky white to brilliant nickel deposits, while the other acids investigated, even in tenfold concentration, had no definite effects. The mechanical properties of the coatings obtained from the solutions containing acetylsalicylic acid, were good. Phthalic acid and phenolphthalein were without distinct effects on the nickel deposition. Tannin is only very slightly soluble in the weakly acid nickel bath, and no distinct effect was to be observed from the small quantities soluble.

Aromatic Nitrogen Compounds

Aniline, Diphenylamine, Benzidine, Diphenylcarbazide, Saccharin, Methyl Red, Methylene Blue.

The aromatic amines produce no distinct increase in the brightness of the nickel, although they markedly increase the polarization of nickel deposition as the curve for aniline chlorhydrate shows. (Fig. 10, Curve 4). The sulphate-free azo dyestuff, methyl red, also has no effect. Methylene blue which contains sulfur, as well as nitrogen, inordinately increases the brightness of the nickel deposits. Concentrations of 0.02 to 0.1 g/l produce brilliant nickel

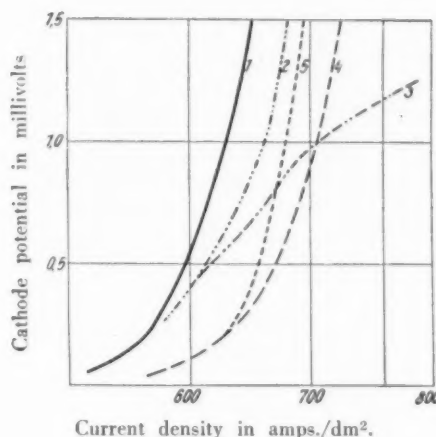


Fig. 10

Influence of aromatic compounds on the course of cathode potential-current density curves in nickel solutions.

1. Standard solution.
2. 0.04 g./l. α -naphthol.
3. 0.1 g./l. α -naphthol
4. 0.5 g./l. aniline chlorhydrate.
5. 0.5 cc./l. furfural.

deposits with reflectivities only slightly less than that of buffed nickel, but they are very brittle, and because of the strong tension, usually exfoliate from the base metal while in the solution. Saccharin, the imide of sulfo-benzoic acid, acts as a rather strong brightener. However, the reflectivity remains below that of buffed nickel. The best effects are obtained with a content from 0.1 to 0.2 g/l, and with higher concentrations, the brilliance begins to slowly recede, with a coincidental gradual impairment of the mechanical properties.

Heterocyclic Compounds

Furfural, Pyridine, Orthohydroxyquinoline, Quinine.

Furfural increases the brilliance of nickel deposits very strongly. A concentration of 0.2 to 0.6 g/l results in nickel coatings with reflectivities only about 10% below that of buffed nickel (Fig. 11, Curve 2). The bright-

* Translated by Dr. Walter R. Meyer from "Der Einfluss Organischer Verbindungen auf die Galvanische Vernickelung", *Zeitschrift fuer Elektrochemie und angewandte physikalische Chemie*, Volume 46, No. 2, February (1940), pp. 71-82

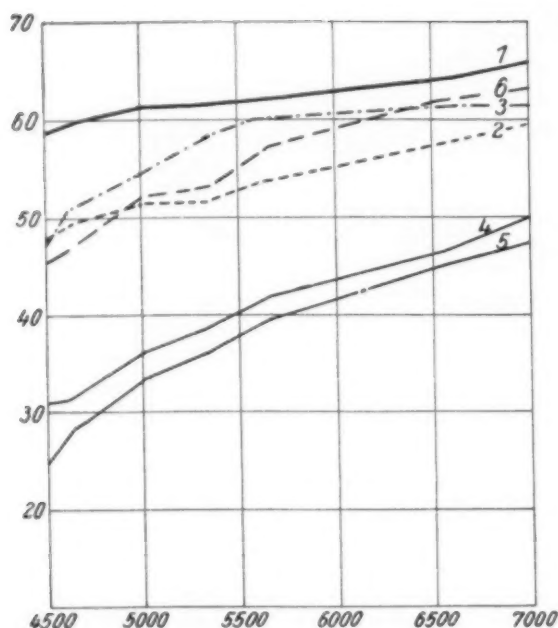


Fig. 11

Reflectivity of nickel deposits from solutions containing aromatic and heterocyclic compounds.

1. From standard solution, buffed.
2. 0.5 cc./l. furfural, thickness of 6μ .
3. 0.5 g./l. beta-naphthalene potassium sulphonate, thickness 12μ .
- 4 and 5. 0.25 g./l. 2-naphthylamine-7-sodium sulphonate, 4 thickness 6μ , 5 thickness 12μ .
6. 0.1 g./l. Nekal, thickness 12μ .

ness of the coatings is independent on the thickness. However, with increasing thickness of coating, they become brittle. Polarization of nickel deposition increases from the use of furfural. A few drops of pyridine per liter result in a marked decrease in the adhesion of the nickel coating to the base metal, without noticeably increasing the brightness of the coating. Orthohydroxyquinoline is a very effective brightener which even exceeds furfural. As long as the addition of orthohydroxyquinoline is not too high, the mechanical properties of the nickel deposits become only slightly poorer. The optimum addition is about 20 cc. of saturated orthohydroxyquinoline solution to every liter of plating solution. The alkaloid, quinine acts as a depolarizer in the nickel solution and at higher concentrations, prevents the further deposition of nickel.

Aromatic and Heterocyclic Sulphonic Acids

ALKALI and nickel salts of aromatic sulphonic acids have been used for some time as brighteners in electroplating, and particularly for producing bright nickel plating solutions. Aromatic and heterocyclic acids have the advantage of good solubility in contrast with aromatic hydrocarbons and their derivatives, and, therefore, the former compounds are easily dissolved in the nickel solution.

Nickel deposits from solutions containing aromatic and heterocyclic sulphonic acids exhibit a few common characteristics. They may, therefore, be considered collectively in spite of their differences in structure and composition.

Nickel deposits obtained from solutions containing sulphonic acids always evolve hydrogen sulphide when they are dissolved in hydrochloric acid. The amount of co-deposited sulphur is dependent on the type of sulphonic acid used and on the current density (Figure 12). A distinct dependency on the concentration of the addition agent in the solution, was not observed. The brightness of the nickel was also independent of the sulphur concentration. The sulphide type of sulphur, detected in the nickel deposits, is not from impurities in the sulphonic acids added to the solution, but rather from the decomposition of the sulphonic acids during electrolysis, whereby the deposited nickel obviously catalytically effects the reduction. This phenomenon is also indicated by the fact that the solutions which contain aromatic sulphonic acids, after a period of use, give off an odor of sulphonic acid-free compounds.

Aromatic sulphonic acids always displace the potential-current density curves in the negative direction. As indicated in Fig. 13, the polarization in an agitated solution was generally higher than that in a still solution. This observation was made several times during the experiments with solutions containing protein.

Twenty-eight sulphonic acids were available for this work, which, in the main, were furnished through the kindness of I.G. Farbenindustrie, A.G., Frankfurt-am-Main. The following individual results were observed:

Potassium phenolsulphonate which was added up to 3.6 g./l., increased the brightness of the nickel deposits very little. The deposits were brittle and had hairlike cracks. Alpha and beta naphthalene sulphonic acids

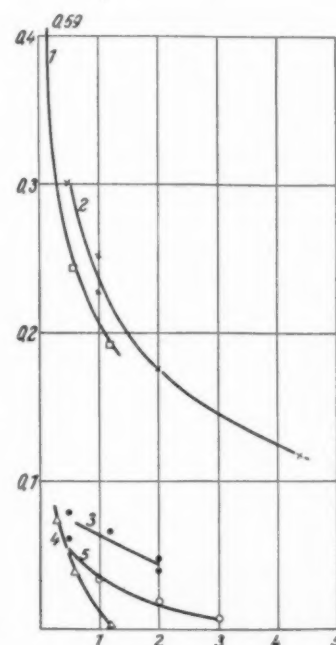


Fig. 12

The sulphur content of nickel deposits from solutions containing aromatic sulphonic acids.

1. 0.015 g./l. 2-naphthylamine-5-sodium sulphonate.
2. 1 g./l. beta-naphthalene potassium sulphonate.
3. 10 g./l. sodium phenolsulphonate.
4. 0.025 g./l. 2-naphthylamine-7-sodium sulphonate.
5. 0.015 g./l. 2-naphthylamine-6-sodium sulphonate.

acted as powerful brighteners, with the alpha naphthalene sulphonic acid having a somewhat more marked effect than the beta naphthalene sulphonic acid. As Fig. 11, curve 3 shows, the reflectivities of nickel deposits from solutions containing beta naphthalene sulphonic acid, were only slightly less than that of buffed nickel. If the concentration of naphthalene sulphonic acid remains small, only a slight embrittlement and reduction of adhesion of the nickel deposits are observed. Higher concentrations cause the deposits to exfoliate on bending. Additions of from 0.2 to 0.6 g./l. were the most satisfactory.

A typical polysulphonate naphthalene, namely, naphthalene-1,3,6. sodium trisulphonate affected the nickel deposits similarly to the monosulphonate. However, no brilliant coatings were obtained with trisulphonates, the brightness usually being only milky and somewhat non-uniformly cloudy. The adhesion and ductility of the deposits were only slightly diminished.

Anthracene-1 sulphonic acid is only slightly soluble in nickel solution. The small quantity which went into solution had no distinct effect on the nickel coatings.

Phenanthrene 3-sulphonic acid in concentration of 4 g./l. has no distinct effect.

The 1- and 2-monosulphonic acids of dibutylnaphthalene in concentration of 3 g./l. produced an excessive turbidity. Bright nickel deposits were obtained, which, however, were only slightly ductile and had poor adhesion. At a concentration of 2 g./l., the brightness remained but the mechanical properties were generally better. Benzyl naphthalene sodium sulphonate, which is only slightly soluble in nickel solutions, caused milky bright nickel coatings whose mechanical properties in comparison with deposits from the normal solutions, were only slightly inferior.

Among the poly-substituted naphthalene sulphonic acids that have been introduced into industry by I.G. Farbenindustrie, A.G., Nekal A even in concentrations of 0.1 g./l., extraordinarily increased the brilliance of nickel coatings. The reflectivities (see Fig. 11, curve 6) were uniformly higher than deposits obtained from solutions containing formaldehyde. The mechanical properties were good; the polarization of nickel deposition was increased strongly. The highest permissible limit lies about 0.5 g./l.; at higher concentrations, the bath becomes turbid and besides, the properties of the nickel coatings become poorer. Leonil, which is obtained by the condensation of naphthalene sulphonic acid with formalin has no noticeable influence on the nickel coatings. Cyclanon L A in concentrations of 0.1 to 0.2 g./l. gives matly-bright deposits with good mechanical properties. Humectol is only slightly soluble in the nickel solution and no effect on the nickel deposit was determined.

Alpha and beta naphthol effect a marked increase in the brightness of the nickel coatings. The salts of their sulphonic acids act likewise. The compounds tested were 2-naphthol-6 sodium sulphonate, 2-naphthol sodium disulphonate (R-salt), 1-naphthol-3,6,8. sodium trisulphonate, and 2-naphthol 3,6,8. sodium trisulphonate. Additions of 0.1 to 0.5 g./l. of these compounds produce deposits with brightness only slightly less than buffed nickel. The polarization of nickel deposition was increased. As is the case with naphthols, however, the deposits are rather brittle and as a result of internal stresses, are covered with hair-like cracks and partly

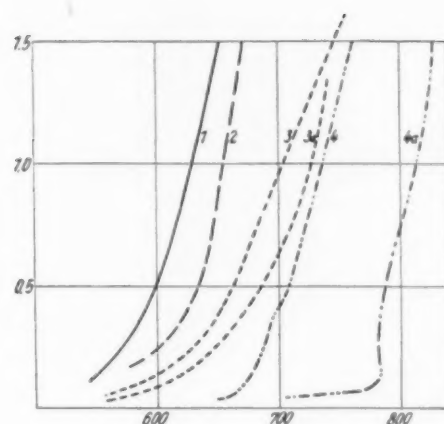


Fig. 13

Influence of aromatic and heterocyclic sulphonic acids on the cathode potential-current density curves.

1. Standard solution.
2. 0.1 g./l. dibutylnaphthalene-1-sulphonic acid and 0.1 g./l. Nekal.
3. 2 g./l. 2-naphthylamine-5-sulphonic acid, still.
- 3a. 2 g./l. 2-naphthylamine-5-sulphonic acid, agitated.
4. 2 g./l. quinoline-8-sulphonic acid, still.
- 4a. 2 g./l. quinoline-8-sulphonic acid, agitated.

exfoliate, even in the solution, from the base metal. In spite of the high brilliance of the coatings bubbles of co-deposited hydrogen adhered very firmly to the cathode surface so that a particularly strong degree of pitting occurred.

The sodium salts of anthraquinone and dioxanthraquinone sulphonic acid act as strong depolarizers in the nickel solution and strongly impair the nickel deposits. The deposited nickel is dark gray to black and adheres very poorly to the cathode.

Four naphtholamine sulphonic acids, namely, 2,5, 2,6, 2,7 and 1,4 compounds in concentrations up to 2 g./l. distinctly increased the brilliance. In comparison with naphthalene and naphthol sulphonic acids, the increase in brightness is only slight. A distinct reduction in reflectivity is observed with increasing thickness of the nickel coating (Fig. 11, curves 4 and 5). Naphtholamine sulphonic acids strongly increase the polarization of nickel deposition (Fig. 13, curves 3 and 3A), and effect a definite increase in hardness without markedly degreasing ductility.

The 2-amino-5-naphthol-7-sulphonic acid shows again the characteristics of naphthols. Bright deposits with poor mechanical properties are obtained.

The sulphonated azo dyestuffs, methyl orange and Congo red, increased the reflectivity of nickel, but, however, only matly-bright coatings are obtained which are very brittle and which partly exfoliate from the base metal even in the solution.

Quinoline-8-sulphonic acid acts similarly to quinoline. In concentrations of from 1 to 5 g./l., it gives matly bright to brilliant coatings with relatively good mechanical properties. If the concentration is increased above 5 g./l., the deposits not only become mat and discolored, but the mechanical properties are also impaired.

EVALUATION OF RESULTS

Aliphatic Compounds

From the results obtained, two groups of brighteners are to be differentiated—the strong and the weak brighteners. Both groups are not sharply differentiated from each other as transitions appear between the two. The strong brighteners occasion bright nickel deposits with reflectivities either equal to or only slightly less than that of polished nickel. Their activity is characterized by:

1. Independence of the brightness on the thickness of the coating.
2. Detectable inclusion of foreign matter in the nickel coating.
3. Marked increase in the polarization of nickel deposition.
4. Increase in hardness and decrease in ductility of the nickel.
5. Frequent appearance of powerful inner stresses in the coatings.

Characteristics 2 to 5 are dependent on the type and concentration of the brightener in the solution. Characteristic 5 is also very strongly dependent on the thickness of the coating.

The weak brighteners only slightly increase the reflectivity of the nickel giving throughout only deposits with mat or milky brightness. Characteristics of weak brighteners are the following:

1. Reduction of brightness with increasing thickness of the nickel coating.
2. Only sporadic detection of co-deposition of foreign matter is possible.
3. Unchanged polarization of nickel deposition or increase of the same.
4. Slight increase in hardness and slight decrease in ductility.
5. Slight sensitivity of the nickel solution towards larger additions of the brightener.

The following compounds of the aliphatic series are strong brighteners:

Formaldehyde, acetaldehyde, thiourea and a few proteins.

Among the weak brighteners are the following:

Alcohols and aldehydes with more than 2 or 3 carbon atoms, polyhydric alcohols from glycerin down, carbohydrates and their compounds, which contain besides the keto group, one or more amino groups. The strong brighteners of the aliphatic series belong to different groups of compounds. They are all similar, however, in the fact that they either dissolve immediately into colloids in the nickel solution, as for example, protein or through decomposition, such as polymerization into colloids as formaldehyde, acetaldehyde, and thiourea. With thiourea, the splitting off of sulphur certainly has some additional significance. From the results with solutions containing sulphonic acid aromatic compounds, the deposition of sulphur does not suffice alone to produce bright deposits.

The weak brighteners of the aliphatic series are substances with more or less long chains and which have relatively large molecules, but which do not form colloidal solutions.

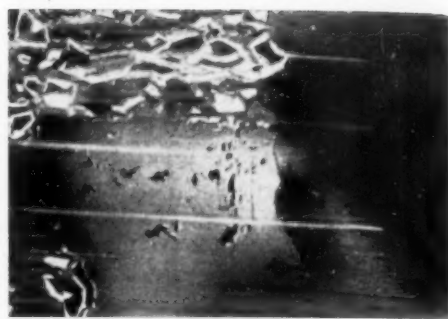


Fig. 14
Hairlike cracks in a bright nickel deposit from a solution containing 2-naphthol-6-sulphonic acid. Mag. 2x.

Aromatic Compounds

The division between strong and weak brighteners for the aromatic compounds is not as marked as with the aliphatic compounds, but nevertheless, there is a distinct correlation between the influence of definite atomic groups in the compounds to their effects on the nickel plating. Since aromatic hydrocarbons and their derivatives are practically insoluble in nickel solutions, their effects must be determined by the use of sulphonic acids or their salts. Since the sulphonic acids are decomposed during nickel plating into the compounds from which they were derived, the study of insoluble aromatic compounds is made possible.

Naphthalene and substituted naphthalenes belong to the class of strong brighteners. The substituted compounds are those in which hydrogen atoms on the nucleus are replaced by aryl or alkyl groups. Naphthols also belong to the class of strong brighteners; phenols on the other hand, increase the brightness little or not at all. Although naphthalene has little effect on the mechanical properties of the nickel coatings, the introduction of an oxy-group into the naphthalene molecule results in brittle and poorly adherent nickel deposits.

With the introduction of an amino group into aromatic compounds, the brightening effect returns. Azo groups, however, cause mat nickel coatings. Compounds which contain naphthol in addition to the azo group, increase the brightness of nickel strongly, as a result of the presence of the naphthol. Sulphur in thiourea compounds acts likewise and thus, for example, methylene blue, a derivative of thiodiphenylamine has marked brightening properties, which, however, similar to naphthol, strongly impair the mechanical properties of the nickel. Brighteners of the aromatic series are uniformly difficultly soluble in water. The possibility is, therefore, offered of obtaining them in a finely dispersed form from the decomposition of their soluble sulphonic acid derivatives whereby the hydrocarbons may enter into the nickel deposits. As a result, it is difficult to determine on what basis these compounds affect the nickel deposits. In part, brighteners have large molecules indicative of colloidal character.

Heterocyclic Compounds

The number of heterocyclic compounds investigated was small. General observations on the influence of the composition and structure of these compounds on nickel plating, may, therefore, not be made.

Electrolytic Metallizing on Non-Metallic Surfaces

By Elias Schore

New York

This is a very practical article on metallizing by one who has had many years of experience. The article has been written at our request and it contains sufficient details so that one should be able to follow them and produce properly metallized objects. A historical discussion opens the article, followed by cited examples of articles that can be metallized. Preparation, striking, and plating solutions are given and individual treatments for specific non-metallies are outlined.—Ed.

Historical

Among the many interesting features of the plater's art is that of metallizing non-metallic surfaces. Before going into the details of metallizing, a brief history of galvanoplasty, as the art is called, may not be amiss at this point in regard to articles which can be plated such as wood, plaster of Paris, flowers, horn, insects, etc.

Since the beginning of civilization, and long before the Christian era, the art of metallizing was known to the Egyptians.

The proof of this knowledge is evidenced by the fact that metallized vases of wood and terra cotta and life-sized statues, weighing not more than a few pounds, have been discovered in the sepulchers of Thebes and Memphis.

However, this process was soon entirely forgotten, during that period of history known as the Dark Ages, and was considered a lost art until the year 1837.

In the spring of that year, Professor H. Jacobi, conceded to be the founder of electrochemical reproduction, presented numerous articles he had produced to the Academy of Sciences of St. Petersburg (Petrograd).

His experiments consisted mostly in the reproduction of metals by depositing on their surfaces a non-adhering metal which could be separated from the original and used as a negative mold. The then Emperor of Russia furnished pecuniary assistance thus enabling Professor Jacobi to continue and complete his experiments. About the same time, others were working along the same lines, notably, Thomas Spencer of Liverpool, England, and J. C. Jordon of London. These gentlemen contested Jacobi's claim to priority in this field of electro-deposition, but it has since come to light that Jacobi



Clock with non-metallic metallized ornaments.

was justified in his claim. It is to Jordon, however, that the world is indebted for the process, since it was he who was first to publish the results of his discoveries in this new and important science.

Robert Murray, in 1840, discovered a method of rendering non-metallic surfaces conductive to electricity by the use of plumbago (graphite) and in 1842, he reproduced the first engraved copper plate by galvanoplastic methods. January 14, 1841, Alexander Jones was granted a patent for "Rendering Surface Conductable," which applied to coating lace, leather, glass, porcelain, wood, etc. with copper. On March 24 of the same year, Alexander Parks patented his process for metallizing of fruit, flowers, animals, and insects. This process and that of Pifford, Hochin, Hearin and Baland are substantially the same and consist of the use of silver nitrate solution differently applied.

Noualheir and Provost in their patent of January 1, 1857, propose to metallize soft surfaces—"a human corpse for instance"—by the following process: "The body is placed in a suitable attitude and pulverized nitrate of silver spread over it by means of a brush or otherwise; it is then electrocoppered in a bath of sulphate of copper, the result being a metallic mummy."

Between the years 1840 and 1860, numerous patents were issued for electrolytically depositing metal on wood, glass, lace, flowers, insects, and plaster of Paris.

The discovery of the utility of galvanic electricity as a means of reproducing objects of metal, the art of galvanoplasty or electrodeposition of metal, had its first impetus, and for many years in England and on the continent of Europe, the artistically inclined had their batteries and cells for the reproduction of metallic objects, and many beautiful reproductions can be found in private and public collections of the early workers in the art. After some years, the art became inert; it has remained inert until the present period except among scientific men and others scientifically inclined, and, in fact, even at the present time very few publica-

tions have done anything to encourage this interesting branch of industry.

Objects That Can Be Metallized

The art of metallizing on non-metallic surfaces does not seem to have been taken up very vigorously by the platers of today.

When one thinks of the possibilities and the field this art has, he is wondering why it has so few adherents. The industry is only in its infancy in this country, but its possibilities are tremendous realizing that it can be used equally as well on hard substances, such as terra-cotta, plaster of Paris, wood, concrete, and pottery, as on soft pliable substances such as cloth, leather, lace, flowers, leaves, the most delicate fabrics, as well as the most delicate insects, for example, butterflies, moths, beetles, etc.

There is hardly a sphere in the commercial world where metallizing cannot be used along such lines as lighting fixtures, table and floor lamps, garden furniture in both terra-cotta and concrete, interior ornamental plaster, ceilings, signs, trade marks, advertising novelties, and almost every phase of art goods, such as statuary, busts, bas reliefs, etc. The chief advantage in this process over bronze casting is that the under-cuts can be preserved and accentuated. The metal can be applied very easily to the most intricate designs, whereas in bronze castings there are many places where it is impossible to get the sharp lines and the deep undercutting necessary to give the art its full strength and beauty. One must bear in mind that this grade of work is only meant to compete with high grade bronze works, and not with cheap white metal casting or brass stampings; many business concerns have not succeeded because they overlooked this simple fact.

In addition to the above-mentioned articles, there is the field of soft substances consisting of flowers, leaves, insects, leather, and delicate fabrics. The reproduction in metal of the beautiful flowers and leaves, (used for brooches, ladies' shoes and belt buckles, trimming for candlesticks, ink stands, etc.) in exact counterpart in every detail of the original does not seem possible, but such is the fact.

All the perishable goods can be made everlasting. Take for instance the first pair of baby shoes, which can be used as paper weights or pin cushions, and can be in the family forever; a flower from a wedding bouquet can be made into a brooch and be enjoyed by the bride for the rest of her life.

As for my part, I have devoted most of my time to the study and practice (having gone as far as to make a cast of my own hand), and I have produced what critics call beautiful specimens; in fact, too good for the trade, because they are so different from the articles now on the market that it is hard to find many people who want to believe that the article they see used to be a genuine flower picked out in the garden, or a leaf of a tree from the wild woods, or a foot of a turkey, or a cast of a human hand.

In my opinion, one cause for the setback of metallization lies in the lack of knowledge of the plater in regard to the finishing and decorating of the subjects.

I find the art of polychrome, Nile Green, Barbedienne, French and Viennese bronzes, antique gold, antique silver, and antique bronze finishes the most suitable for the purpose, since all of these finishes must be applied by cold dips and stains with the aid of dry metal powders and pigments; they are hard to produce, and I think that is one of the reasons why the metallization is so far behind as an art and so little known by the platers in general.

In my opinion, it is up to the plater and to the artist to develop it; I firmly believe a large reward will compensate in the end the little trouble they will encounter in the beginning.

In this article, it is the intention of the writer to give such information on the subject of metallizing of non-metallics so that an expert plater as well as an intelligent assistant plater can very readily learn to reproduce these beautiful objects in metal.

I do not claim anything new either in the process or methods used, but I do believe that the operations when followed carefully will give as good or better results than any other method now in vogue. The article was written with the intention of giving a brief outline of plating on non-metallics; there is no intent whatsoever of deriding or disputing any other articles which have been written on this subject in the past.

Preparation

On studying the underlying principles, the treatment of any substance is comparatively simple. The thoughts to bear in mind are to cover the article with a metallic film so that the deposit can get started, to safeguard the piece from becoming saturated while suspended in the plating solution, to choose a metal that will cover easily and quickly, and one that can be deposited quite heavily.

In preparing non-metallic surfaces for metallizing, it is first necessary to divide them into two classes: those that are very porous, such as plaster of Paris, terra-cotta, wood, and the like; and those that are less porous, such as leather, bone, horn, fruit, flowers, closegrain woods, glass, and porcelain.

The first operation in metallizing plaster of Paris, terra-cotta, or wood, after they have been thoroughly dried, is to make them absolutely acidproof. Unless this is done, the solution will penetrate the article and spoil it. To prevent this, the articles are first soaked in a solution of the following composition:

Acidproofing Composition

Beeswax	2 lbs.
Paraffine	6½ "
Rosin	1½ "

The melting point of this composition is about 220°F., and the articles must remain entirely covered in it for at least 30 minutes, after which time they may be removed and allowed to cool. Another method of checking whether the article has been saturated well enough is to watch until the solution stops bubbling.

The next step is to give the articles to be metallized two coats of shellac and allow them to dry thoroughly



Metallized plaster of paris statue.

in the air for about three hours. I find it desirable to use the following mixture of shellac: In one gallon of denatured alcohol, dissolve 3½ lbs. orange flake shellac and add to it ½ lb. red lead.

To those articles having deep recesses and high projecting parts, apply a coat of varnish. After the coat of varnish is applied, brush good to get an even coating and hang aside until it becomes tacky or almost dry, which takes about one hour or more, depending on the consistency of the varnish. I found one part copal varnish to three of turpentine the best for this purpose. This is applied with a brush, any kind will do, as it will flow out smoothly no matter how you put it on.

Now we are ready to apply the copper powder. Get the finest copper lining powder that you can because the old rule holds good here as well as in other plating processes; that is, the smoother the surface you start out with, the smoother the final coat will be, especially is it true in this case as we put on a heavy deposit.

The bronze powder is put on with a camel's or badger's hair brush, and well brushed all over, so that no spot is missed, as they will not cover when put into the solution.

After this, the wires are attached very carefully, so as not to scratch the work with same. After thorough drying, the surplus bronze powder is washed off under a faucet or with a hose so as to get all over a fair pressure of water, as on this depends largely the smoothness of your deposit. Now pour over the work some silver dip solution, so as to whiten the copper bronze. Look it over well for spots as they are now plainly

seen, and can be touched up with a little varnish and bronze powder, and then allow it to dry.

Striking

The surface of the article is now coated with copper and is a conductor of electricity. Plating in an acid copper solution may now be carried on if desired, but it will be found that the copper deposit does not form evenly until after some time. If sufficient time is taken, however, very good results can be obtained, but it has been found preferable to "strike" the article coated with copper powder in a silver solution so that the surface will become coated with metallic silver. Electroplating done on this takes place very evenly. The "strike" is made as follows:

Water	1 gal.
Sodium Cyanide	3½ ozs.
Silver Nitrate	3 "

In case the solution is not clear, add a little more cyanide, but to work well there can be little or no free cyanide present.

This "strike" is used without any current and the article, now coated with copper powder, is immersed in it for a few seconds. The copper is coated by the silver in the solution.

Work not having very deep under-cutting may be sprayed as follows: First coat with a mixture of:

Tin powder	2 ozs.
Bronze medium	½ pint
Bronze medium thinner	½ "

After allowing to dry for one hour, spray with a second coat of the following:

Copper plating bronze powder	3 ozs.
Bronze medium	¼ pint
Bronze medium thinner	¾ "

The use of the tin powder is not essential, but its use is advocated here to detect that the article is thoroughly sprayed with the copper powder, an aid in the spraying of the copper powder. If the article is not covered thoroughly, the tin powder will show.

After they have been sprayed with copper powder,



Metallized plaster of paris statues.

they are allowed to dry in the air for from three to four hours; they are then ready for the bath.

Busts and Plaques

Busts and plaques are prepared in the following manner: After waxing and shellacing, mix two quarts of pure benzol with one teaspoon of rubber cement. Paint the article evenly and quickly, let it dry for about a half hour. It is then ready for black leading. Use light graphite first, then use dark graphite and finish with the light graphite that was first used. Then coat with a copper sulphate solution and sprinkle with iron filings. Go over lightly with a fine camel hair brush. Wash well with water and the article is then ready to go into the copper bath.

Plaster Casts

Plaster casts of a fine relief nature and soft modeling (i.e. human hands, negatives for reproduction) are treated as follows: After thoroughly drying, the article is dipped in ceresin wax. Ceresin is a refined ozokerite wax whose melting point is between 150° and 160° F. Having waxed, thoroughly dried, and wiped off the deep recesses, the article is placed in a dilute alcohol solution and washed in distilled water; while the article is still wet, pour or dip it in the following solution:

Silver nitrate	1 oz.
Distilled water	4 ozs.

Rinse again with water then dip or pour on the following solution:

Iron chloride	1 oz.
Water	3 ozs.

Allow it to dry between three and five minutes. This operation must be repeated from three to five times until the article turns a silvery gray color. After again rinsing in water, the article is ready to be plated. This is known as the "L. Berlandt Process."

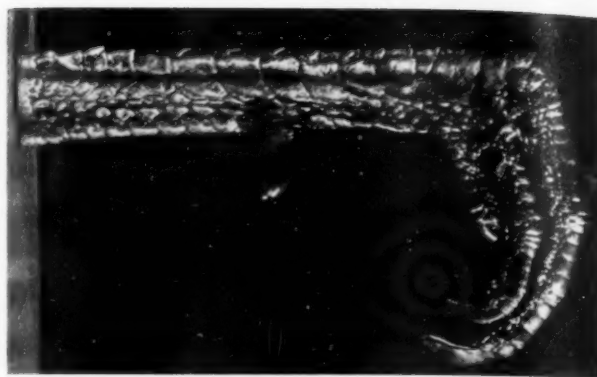
In outlining these processes, I have in mind the one I used when I had charge in Katahdin Bronze Works and Dymalkon Metals Corporation, and will endeavor to explain some of the little "shop tricks" we devised for handling work in quantity.

First of all, in doing plaster of Paris, we would insert a screw in the base while the plaster is setting, having the screw flush with the bottom and where it would not show when the piece was completed. The only exception was on lamp bases which had an iron pipe of suitable size cast into them for the final operation of wiring as a lamp.

The advantage of having a screw cast into the base instead of the usual piece of copper wire, was that we could fasten a rack to this screw when starting out and leave it on through the whole procedure from start to finish; the same holds good with lamp bases as the rack does two-fold duty here: it screws into the end of the pipe afterward used for a socket or light cluster, and prevents the threads from being coated.

An added advantage of using rigid racks is that the work can be handled easier in subsequent operations and prevents them from striking each other while moving in the plating bath.

Our racks were arranged in such a manner that we



Metallized chicken's foot.

had a loop about half way up, upon which they could be hung while work was being prepared for metallizing.

The extreme top of the rack was straight, to be inserted in the hole in the cathode rod, where thumb screws would fasten it. This would prevent plaster articles, which were not weighted, from floating on top of the solution. Where weight was desired, pieces of scrap iron were cast into the article.

These racks could be used over and over again, and owing to the alternate layers of copper and shellac the deposit was easily removed when it became too heavy. On the bottom of the rack, where it fastened to the work, was a small brass button which would draw up against the object to be plated and would insure good contact.

In preparing articles mentioned in the second class, all that is necessary is to have them well shellaced, giving them at least two coats and letting them dry thoroughly. Then use any one of the aforementioned formulas, with the exception of the silver nitrate formula mentioned for the high class plaster, after which they are ready for the plating bath.

Baby Shoes

With regard to baby shoes the treatment is as follows: First button or lace the shoe. Dip it in shellac three times, one hour drying after each dipping; after the last dipping, place the shoe in its original shape, filling it with rags or paper. Place it in the oven to dry overnight, with one gas-burner and the door a little open. The following morning the shoe is bone dry and is ready



Metallized leaf.

for any of the above-mentioned processes, but I prefer for quality work "graphite." After fine polishing down of the graphite with a soft hand brush, the shoe is left with every detail, every wrinkle in the shoe can be seen.

Flowers

In the plating of flowers and insects the methods used have to be modified because of the delicate nature of the work. Flowers should be gotten as fresh as possible and before they have become dry and dilapidated should be immersed completely in a shellac solution and then swished back and forth to throw off all excess shellac. For this class of work, use the following mixture of shellac: Six ounces orange flake shellac dissolved in one quart of alcohol, no red lead is to be used in this shellac. After drying, dip them a second time and after they are dry, dip once more in a solution of $1\frac{1}{2}$ ounces silver nitrate dissolved in 2 ounces of distilled water, after adding 1 ounce of aqua ammonia and 2 ounces grain alcohol. The articles are then placed in a tight box and subjected to fumes of hydrogen sulfide, prepared by placing iron sulphide in a dish, covering with water and adding sulphuric acid until the action is visible.

In metallizing insects, it is advisable to first smother them with chloroform. Next stick a pin through them to which a fine copper wire has been attached. They can be treated the same as the flowers.

The turkey foot and other animal matter, I allow to soak for twenty-four hours in a solution of $\frac{1}{2}$ ounce of mercury bichloride in one quart of water and then let it dry for twenty-four hours, after which it receives the same treatment as the other articles.

The mercury bichloride kills the marrow and animal tissue.

Plating

Any desired thickness of metal can be deposited. The thickness depends upon the length of time the work is run in the plating bath, generally between 8 and 35 hours, depending upon the thickness one desires.

The best solution I have used for this kind of work is made as follows:

Water	1 gal.
Copper sulfate	25 ozs.
Sulphuric acid	5 "
Ammonia alum (free from dirt and impurities)	2 "

To every 1,000 gallons, I add one quart of best grade corn molasses as a brightener.

The solution should be kept in an agitated condition by means of air, as the agitation is very important; in fact, more so than one would at first suppose. An agitated solution produces a more even deposit of copper and a better quality, preventing the forming of gas bubbles or streaks, both of which very often cause the plater a great deal of trouble, but which are seldom or never seen in an agitated bath.

A higher current may also be used, resulting in an increased rate of deposition.

When the work is placed in the bath, it is started at 1 volt and continued for about three hours after which

the voltage should be increased to between $1\frac{1}{2}$ and 2 volts and run at this rate until the desired thickness is obtained.

The amperage would have to be determined from the area of the cathodes. About 20 amperes per square foot at this rate, the deposit will be about 0.001" thickness per hour.

Operation of the acid copper bath may result in the depletion of the copper content, due to the accumulation of iron from the pipings in the lamps; this may be avoided by stopping off all the exposed iron pipings by means of wax or varnish.

The action of iron in an acid copper bath is little understood. Any excessive iron in the bath usually produces streaked deposits. These streaks, as a rule, run vertically and frequently get so bad that they ruin the appearance of the deposit.

Another cause for the depletion of the copper content of an acid copper bath may be due to the anode efficiency being lower than the cathode efficiency. This means that the anodes will not dissolve with sufficient rapidity to maintain the copper content of the bath at the proper value. When this occurs, the solution becomes too acid. The bath must be so regulated that the anodes will work cleanly. If anode slimes form, they act as insulators. They reduce the active area of the anode, raise the active anode current density and cause a rapid depletion of the copper content of the bath.

If the copper content becomes depleted, the cathode current efficiency decreases and the time required for plating increases. It is important to analyze the solution periodically to determine the copper content; when low, the addition of copper sulfate in quantities will restore the bath to its normal operating limits.

On the other hand, when the copper concentration is too high, the deposits may be streaked or there may be treeing at the edges or corners. When such symptoms occur, it is a definite indication of an unbalanced solution. This unbalanced condition is between the copper sulfate and the sulphuric acid contents. A balanced solution can be obtained only after a quantitative analysis has been run and the proper adjustments made.

Now to get back to the work in process. When it is removed from the tank, rinsed in cold water and let dry, it is then ready for polishing and buffing.

Grinding is not necessary if the work is not run too fast or too long, but when it is, just touch up spots which are rough on a polishing wheel of proper size.

All my work was finished by sand buffing with a rag wheel, pumice and grease oil, because in that manner I could get a good surface without heating the articles and without loading it up with buffing compositions hard to remove.

Right here let me emphasize the necessity of keeping a metallized object away from heat as much as possible. When it comes out from the tank, do not dip it into hot water; when you buff keep it as cool as possible; when you clean buffed work, keep it out of hot cleaners as much as possible and so on right through to the final operation. The reason is this: With the various substances underneath the copper shell, including the wax, the heat would separate the copper shell and although it would not fall off you would always have a loose unsatisfactory deposit.

Record Attendance at Atlantic City

Meeting of A. S. T. M.

With a record-breaking attendance and more new specifications and tests approved than at any other meeting, the 1940 A.S.T.M. Annual Meeting held at Atlantic City, June 24 to 28, was also marked with important activity in specific fields. The registration of members, committee members, and visitors, totaling 1,441, exceeded the previous Atlantic City meeting high in 1939 of 1,354, and is second only to the New York City attendance in 1937 of 1,523.

It was announced that the 1941 meeting of the Society would be held in Chicago, June 23-27, at The Palmer House, at which time there will be the Society's Sixth Exhibit of Testing Apparatus and Related Equipment.

An indication of intense activity in standardization and research in materials was shown, not only by the 22 formal technical sessions, but also by the more than 250 committee meetings in progress throughout the five days of the meeting. Over 110 papers and reports were presented at the sessions. Many of the committees this year also sponsored informal technical programs as part of their meetings, including the presentation of informal papers.

In the standardization field, new tentative standards totaling some 77 were approved, the largest number yet acted on at an annual meeting. The number of existing specifications adopted as standard totaled 40 which is considerably less than last year but in 1939 the Society issued its current Book of Standards and the number of tentative specifications advanced to standard is always higher in a Book of Standards year. When the letter ballot action of the Society is taken on the various recommendations approved at the meeting, the Society will have on its books close to 950 standard and tentative specifications, tests, and definitions, a net increase of 65 over the previous year.

The Society's Third Photographic Exhibit created much interest and also a special display of radiographs and other items in this field, the latter being sponsored by Committee E-7 on Radiography.

Two significant addresses on specifications for materials were highlights of the meeting. The first, *H. H. Morgan's* Presidential Address, stressed the commercial importance of specifications; the second, by *Lt. Col. W. C. Young* of the War Department, indicated their significance in national preparedness.

Presidential Address—Commercial Importance of Materials Specifications:

In his Presidential Address, *H. H. Morgan*, Robert W. Hunt Co., stated that the important specifications are standards of trade and that standardization has been the bedrock of civilization. He pointed to some of the specific advantages of using good specifications.

These may be listed as follows: (1) they enable the buyer to get what he wants; (2) the material is of uniform quality; (3) the buyer receives goods more quickly and with less trouble; (4) he has access to wider markets; (5) costs are lower; (6) a suitable acceptance basis is established; (7) material becomes standardized, and (8) research is promoted.

Mr. Morgan stressed the fact that the practical importance of specifications hinges directly on their ability to assure the buyer that he is receiving exactly the goods he orders. In the competition of trade, particularly in regard to heavy products under mass production, it is essential to know that materials are furnished according to specifications.

Material Standards in National Preparedness:

In clear and unmistakable terms Colonel Young outlined the significance of industrial mobilization and the importance in this program of adequate materials specifications. He covered such factors as materials needed and quantity, and factors involving production and educational orders as well as production studies, mentioning the careful consideration which has been given to the economic factor. The work of the Munitions Board was covered and particularly the industrial mobilization plan which is a guide to be available in time of a major war. Colonel Young stressed the various specifications issued by Government bodies and pointed to the close cooperation of the War Department and the various Federal departments and also the work of the various technical societies including A.S.T.M., citing that this organization was in an excellent position to make an important contribution in the field of standardization. He also pointed to the significance of careful inspection of materials. He stated that there are a great number of organizations in the United States actively engaged in standardization work covering many fields. In the event that the nation is faced with a major

emergency, it may be expected that activities of these societies and organizations, especially of leading organizations such as A.S.T.M., will be of great assistance in bringing it to a successful conclusion.

An outstanding lecture was presented by *P. H. Bates*, the Fifteenth Edgar Marburg Lecturer. Mr. Bates, Chief, Clay and Silicate Products Division, National Bureau of Standards, and long-time chairman of Committee C-1 on Cement, discussed portland cement. He pointed out that it was impossible to define this material in the dictionary manner and that the possible best that can be done is to refer to it as largely a mixture of finely ground synthetic highly basic lime silicates with which are present lesser amounts of highly basic lime aluminates, lime alumino-ferrates, and solid solutions of these with (or compounds of) the many adventitious oxides found in clays, limestones, and the other raw materials used in cement manufacture.

Award of Charles B. Dudley Medal:

The 1940 Award of the Charles B. Dudley Medal was made to *T. F. Willis* and *M. E. De Reus*, Research Engineer, and Junior Engineer, respectively, Bureau of Materials, Missouri State Highway Department, for their paper presented at the 1939 Annual Meeting on "Thermal Volume Change and Elasticity of Aggregates and Their Effect on Concrete." This paper was considered an outstanding contribution to research in engineering materials.

New Officers:

W. M. Barr, Chief Chemical and Metallurgical Engineer, Union Pacific Railroad Co., succeeded *H. H. Morgan* as President; *H. J. Ball*, Professor of Textile Engineering, Lowell Textile Institute, was chosen Vice-President to serve with *G. E. F. Lundell*, Chief, Chemistry Division, National Bureau of Standards, who was elected Vice-President in 1939.

New Honorary Members

Three long-time and active members of the American Society for Testing Materials were awarded honorary memberships at the Forty-third Annual Meeting held in Atlantic City, June 24 to 28. These awards to *Cloyd M. Chapman*, *H. E. Smith*, and *T. R. Lawson* were made for outstanding service to the Society and

notable accomplishments in the field of engineering materials.

Mr. Chapman studied at Cornell University and later was associated for many years with Thomas A. Edison. For 15 years he was affiliated with Westinghouse, Church, Kerr & Co., as construction engineer and later as engineer of tests. He specialized in power plant and manufacturing plant design and construction. Active in a large number of Society committees in many fields he has been an officer of many groups—was chairman of Committee C-9 on Concrete and Concrete Aggregates and of the important Committee E-10 on Standards. He was President of the Society from 1932 to 1933.

An M.I.T. graduate, Mr. H. E. Smith, a member of the Society since 1902 was affiliated continuously with the railroad field until 1932. For many years he was engineer of tests and later, engineer of materials, of the New York Central Railroad. During the World War he was in charge of the inspection of materials for new equipment purchased under the U. S. Railroad Administration. Mr. Smith has done important work on various committees in the field of steel, corrosion, and wrought iron. He has just completed a term as chairman of the Society's Committee D-1 on Paint, Varnish, Lacquer, and Related Products and has been reelected. He was a member of the Society's Executive Committee from 1929 to 1931.

T. R. Lawson, Emeritus Professor, Rensselaer Polytechnic Institute, was for over 40 years a member of the R.P.I. faculty and for many years headed its Department of Civil Engineering. He has been a consulting engineer in connection with a number of bridges and other problems. His activities involved in particular work on brick and other manufactured masonry units, especially in connection with the simplification of varieties and sizes of brick. He has been a member and an officer of a number of A.S.T.M. committees. He served as a member and chairman of its Committee E-10 on Standards and was President of the Society from 1933 to 1934.

Sessions on Non-Ferrous Metals

Two complete sessions of the Forty-third Annual Meeting of the American Society for Testing Materials held in Atlantic City, N. J., June 24 to 28, were devoted to papers and reports in the field of non-ferrous metals. In the first of these sessions the report of Committee B-5 on Copper and Copper Alloys Cast and Wrought was outstanding. The committee's activities have been intensified in recent years. During the past year a number of materials coming under the scope of the War Department have been studied and new tentative standards issued to cover them. In all of this work the War Department has cooperated closely. Seven new specifications were approved for publication covering the following:

Specifications for Cartridge Brass Cartridge Case Cups

Specifications for Gilding Metal Sheet and Strip

Specifications for Gilding Metal Bullet Jacket Cups

Specifications for Copper Rods and Bars

Specifications for Brass Wire

Specifications for Miscellaneous Brass Tubes

Specifications for Leaded High-Strength Yellow Brass (Manganese Bronze) Castings.

Several of these items pertain to materials not previously covered in A.S.T.M. specifications.

A number of changes were made in the committee's tentative and standard specifications, all of these being detailed in the report.

The Chairman of Committee B-5, C. H. Greenall, Bell Telephone Laboratories, detailed various changes in the report as developed at the B-5 meeting at Atlantic City and also reported agreement on new specifications which will cover 25 copper-base alloys in ingot form for sand castings. After letter ballot in the committee, this new specification, which is of interest in connection with the national preparedness program, will be referred to the Society's Committee E-10 on Standards for approval. When approved, the new



Cyril S. Smith

item will replace the existing Specifications B 30.

So that the committee's work may be tied in even more closely with the Government specification bodies, the committee plans to designate special advisers to its Advisory Committee from the Ordnance Department, Navy Department, Air Corps, etc.

In his paper on "Proportional Limit Tests on Copper Alloys," Cyril Stanley Smith, Research Metallurgist, American Brass Co., described methods for insuring axial loading on tension test specimens in order that studies under way would result in a better understanding of the basic effects of composition, structure, and treatment upon the elastic and inelastic behavior of commercial copper-base alloys.

Of major interest in the report of

Committee B-2 on Non-Ferrous Metals and Alloys was its new tentative specifications for pig lead, replacing immediately the existing Standard B 29. Based on a great deal of study, the committee overcame various difficulties in its original proposals, primarily the method of arrangement, and classification of the several types of metals covered. The specifications cover refined lead in pig form made from ore or other material by processes of reduction and refining. The following types of lead are covered: corroding lead, chemical lead, acid lead, copper lead, common desilverized lead A, common desilverized lead B, and soft undesilverized lead. A detailed table of chemical requirements is included in the specification.

In this session were three technical papers of interest in the field of lead cable. The first covered a method for making reproducible hydrostatic bursting tests of cylindrical lead specimens, by H. S. Phelps, A. M. Gates, and Frank Kahn of the Philadelphia Electric Co. Based on test data now being obtained it is hoped that the kind of lead or lead alloy best suited to withstand internal pressure can be selected.

Messrs. Moore, Dollins, and Craig of the University of Illinois in a companion paper described work carried out in cooperation with the tests previously mentioned. This involved comparative tests to fracture under long-time steady load and were made by subjecting full sections of lead cable sheathing to internal oil pressure and by testing tension test specimens cut with the axis in a circumferential direction from pieces of the same sheathing.

The second of the two sessions devoted to non-ferrous metals included reports of four of the Society's standing committees, with five technical papers. Four of these involve discussions on anodic coatings. In its report on die-cast metals and alloys, Committee B-6 recommended a slight revision of the magnesium-base die-casting specifications B 94, and included as an appendix to its report a description of the examination and tests of specimens removed from the exposure racks after an atmospheric exposure of 5 yrs. The results, as expected, show relatively small differences between the several materials, largely because corrosion has not progressed to a significant degree. The committee did include a statement that visual examination confirmed the accelerated tests in indicating that the high purity alloys are more resistant to attack—at least sea-coast locations—than the present commercial grades, although in industrial locations the soot and dirt deposits mask the small differences in resistance to corrosion which exist at the end of 5 yrs.

The four papers on anodic coatings were arranged under the auspices of Subcommittee VI on Anodic Oxidation of Aluminum and Aluminum Alloys which functions as a division of the Society's Committee B-7 on Light Metals and Alloys.

The first paper by *F. Keller*, Aluminum Company of America, discusses anodic coatings seen through the microscope and describes the various methods which have been developed. *J. D. Edwards*, Aluminum Company of America in his paper on "Thickness of Anodic Coatings of Aluminum," discussed thickness measurements, which knowledge of coating helps to determine its usefulness for a variety of purposes.

H. G. Arlt, Bell Telephone Laboratories, in his paper on "The Abrasion Resistance of Anodically Oxidized Coatings on Aluminum" stated that an air-blast type of abrasion test can be successfully employed. The results of this study indicate that careful control of testing conditions produced abrasion data of a high order of precision. Before adopting this method for inspecting, it would be desirable to conduct a confirmatory cooperative test.

A means of checking thickness of anodized finishes was described by *K. G. Compton* and *A. Mendizza*, the method being the electrical breakdown of anodically oxidized coatings on aluminum. Data are given which show the relationship between breakdown resistance, anodizing time, thickness of coating, current density and sealing of anodically oxidized polished commercially pure aluminum. Statistical data for the values obtained are also given, indicating the good reproducibility of the breakdown values. By calibrating a particular anodic process, satisfactory results may be obtained in a relatively short time and often without destroying or marring the article.

Based on the work of Subcommittee VI two new tentative tests were approved covering test for weight of coating on anodically coated aluminum and test for sealing of anodically coated aluminum.

Among the recommendations of Committee B-1 were proposed new tentative specifications for bare rope-lay-stranded and bunch-stranded soft copper cables for electrical conductors, but these specifications were not presented since it developed that they were not entirely satisfactory in their present form and were referred to the subcommittee in charge for further study. If it is not possible to have the Society act on the specifications during the year the committee plans to have the specifications, as revised, published in the *ASTM BULLETIN*.

Proposed revisions in the twist test of Specifications B 49 were revised and the committee believes that these also will be published as information and comment prior to their final publication.

Intensive work on electrical heating, electrical-resistance, and electric-furnace alloys is being carried on by Committee B-4. A new tentative method of testing sleeves and tubing for radio tube cathodes was approved. The test procedure involves the dimensions and physical properties of the material.

While Messrs. *Marin* and *Zwissler* in their paper on "Creep of Aluminum Subjected to Bending at Normal Tempera-

tures," stated that a reasonably good agreement was found between test values and those obtained theoretically based on a theory developed using tension creep test data as a basis, *R. G. Sturm* of the Aluminum Research Laboratories mentioned that experimental determination of creep values requires extreme care of measure. He pointed out that under constant stress, creep at ordinary atmospheric temperatures is not a linear function of time.

Corrosion Discussed

The Eleventh Session of the 1940 A.S.T.M. Annual Meeting held in Atlantic City, N. J., June 24 to 28, was devoted to the subject of corrosion with extensive reports by Committee A-5 on Corrosion of Iron and Steel and B-3 on Corrosion of Non-Ferrous Metals and Alloys, the latter including two appended papers.

An important new tentative standard was approved as developed by Committee A-5 covering a test for Uniformity of



Dr. W. A. Wesley

Coating by the Preece Test (Copper Sulfate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles. This method is really a combination of the former tests pertaining to iron or steel wire (A 191-38) and steel castings and forgings, gray iron and malleable iron castings (A 208-38 T), but has been extended to apply to hardware shapes, threaded materials, and the like. For a year at least the Methods A 191 and A 208 will be continued.

Revisions of the Tentative Specifications for Electrodeposited Coatings of Zinc on Steel (A 164-39 T), Cadmium on Steel (A 165-39 T) and Nickel and Chromium on Steel (A 166-39 T) were approved providing for inclusion of requirements for a thicker coating class in the zinc, and in the nickel and chromium coatings, and an intermediate thickness of coating in the specifications covering cadmium coatings.

The report also discussed the results of

the committee's researches involving field tests and included a final report covering total immersion tests in sea water of sheet steel and wrought iron specimens, and tubing, exposed since 1927 at Portsmouth, N. H., and Key West, Fla. Conclusions which the committee in charge felt could be drawn from the results were itemized and included the fact that the spread in time of failure is great and that the difference between different kinds of material is small with respect to the spread in time. The relative order of failure of the different materials is not the same at the two test locations.

One of the most interesting conclusions was that the addition of copper increased the life of all the materials under test with the exception of high-phosphorus steel at both locations and that the open-hearth iron lasted longer than the basic open-hearth steel in both the high- and low-copper groups. The average chemical analysis of the materials indicated that in the copper-bearing materials the copper content was about 0.25.

Messrs. *N. B. Pilling* and *Dr. W. A. Wesley*, The International Nickel Co., Inc., in their paper on "Atmospheric Durability of Steels Containing Nickel and Copper" outlined the results of extended series of atmospheric corrosion tests, some of which had been under way for 15 years. A general conclusion from this work is that the beneficial effects of nickel upon the weathering resistance of steel increase with increasing nickel content and are enhanced by the addition of optimum amounts of copper. The superiority of nickel-copper steels over copper steels is particularly pronounced they concluded. The effects of manganese, silicon, and carbon contents do not appear to be important but the presence of a moderate amount of phosphorus seems to be beneficial in nickel-copper steels.

The report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys included two appended papers, one by Messrs. *F. L. LaQue* and *G. L. Cox*, The International Nickel Co., on "Some Observations of the Potentials of Metals and Alloys in Sea Water." The second paper by *Dr. W. A. Wesley* covered "Controlling Factors in Galvanic Corrosion."

It was announced in the report that in cooperative work with other committees and with the Joint Committee on Exposure Tests of Plating on Non-Ferrous Metals proposed specifications for electrodeposited coatings of nickel and chromium on copper and copper alloys, and on zinc and zinc alloys had been prepared and would probably be submitted to the Society for approval in the near future.

Dr. William Blum, National Bureau of Standards, in presenting a brief report of the Joint Committee on Exposure Tests of Plating on Non-Ferrous Metals stated that the outdoor tests of electroplated nickel and chromium coatings on steel and non-ferrous metals were practically completed, the results having been published as Research Paper RP1293 by the

Bureau. Copies of this report are available in separate pamphlet form at a nominal charge. As a result of the committee's work proposed specifications were developed as referred to above in the discussion of the work of Committee B-3.

Fatigue and Corrosion-Fatigue Discussed

For many years the annual meetings of the American Society for Testing Materials have featured papers and reports on the subject of fatigue of metals. At the 1940 annual meeting, one complete session, the Thirteenth, was devoted to this subject with an informal report of the Research Committee on Fatigue of Metals and six technical papers. One of the items was an interesting discussion of "Fatigue of Porous Metals." The authors, Messrs. C. G. Goetzel and R. P. Seelig, American Electro Metal Corp., and Powder Metallurgy Inc., respectively, described how they pressed bars of powdered metals which were sintered to contain controlled amounts of porosity. Fatigue specimens were tested in the Moore-Wisbart machine and S-N curves were recorded for both copper and iron and the results compared with those of cast copper and ingot iron, respectively. They concluded that the reduction in cross-sectional area between pores alone cannot be responsible for the reduction in fatigue limit. On the other hand, the stress-raising effect which was expected to reduce the fatigue limit to a greater extent seems relatively low. It would seem probable from experiments on multiple stress raisers closely spaced together that a general porosity might reduce the stress concentration at each individual pore. The authors stated that the influence of corrosion had not been covered by the investigation. It is quite possible that corrosion-fatigue phenomena are more pronounced in porous specimens than they are in solid ones.

Results of a fatigue investigation made on axles tested as rotating cantilever beams 2 in. in diameter with surfaces metal coated and flame hardened were reported by Messrs. O. J. Horger and T. V. Buckwalter, The Timken Roller Bearing Co., this investigation being part of a project on axle research which has been under way for about five years. Axles with and without stress concentration were sprayed with a metal coating. Also axles with stress concentration were locally flame hardened. Fatigue tests were made on these specimens and comparison made with similar axles without surface treatment.

The base axle materials were S.A.E. 1035 and 1045 steels and the sprayed metal was 0.40 and 1.20 per cent carbon wire stock. The nature of the stress concentration was a press-fitted wheel. Test

results with plain specimens indicated little difference in endurance limit of coated axles over that for uncoated axles. Press-fitted wheel and axle assemblies showed a great increase in endurance limit of the coated and flame-hardened axles over the untreated axles.

In a paper of interest to this same field on "The Effect of Protective Coatings on the Corrosion-Fatigue Strength of Steel" Prof. T. J. Dolan and H. H. Benninger of the University of Illinois, gave the results of laboratory tests on various steels with protective coatings.

All specimens were subjected to completely reversed cycles of flexural stress while in contact with fresh tap water. It was found that the corrosion-fatigue endurance limits for all coatings except the silicon impregnation were considerably below the endurance limits of the uncoated material in air. The specimens with the silicon impregnation coatings exhibited the same endurance limits in air and in water, but the value of the endurance limit was only about 22,500 psi.

The zinc-plated specimens had a somewhat higher corrosion-fatigue endurance limit than did the cadmium plated specimens but both platings gave endurance limits less than 45 per cent of the endurance limit of the uncoated material in air.

The chief effect of the electroplated coatings seemed to be a lengthening of the time (and number of cycles of stress) required to cause failures of the coated specimens in corrosion-fatigue.

The nitrided case was very efficient in resisting pitting due to corrosive attack and the corrosion-fatigue endurance limit of the nitrided specimens was the highest obtained (85,000 psi.) from any of the materials tested. Several tests of specimens coated with bakelite varnishes indicated that an increased corrosion-fatigue strength would be developed if a continuous impervious coating can be maintained.

D. G. Watt, Junior Testing Engineer, The Hydro-Electric Power Commission of Ontario, in his paper "Fatigue Tests on Zinc-Coated Steel Wire" pointed out that the progressive failure of overhead conductor cables due to aeolian vibrations presents a serious problem to engineers responsible for the design and maintenance of power transmission lines. A great amount of study has been devoted to the cause and nature of conductor vibration and to the devising of mechanical dampers to suppress it below a harmless limit. Coincident with the advances which have been made in restricting the intensity of cable vibration to the point where indefinitely long or at least extended conductor life will result, efforts have been made to obtain conductor materials with the best possible fatigue char-

acteristics and to continuously check, by suitable test methods, the fatigue properties of the materials from which the cable is fabricated. In studies of the simple reversed bending fatigue test made on zinc-coated steel wires of three grades of ultimate strengths, the general conclusion was that the endurance limit increased with the ultimate strength while the endurance ratio diminished. Wire from the same reels tested in the lead-annealed and hot-dip galvanized conditions showed the deleterious effect of the coating process on the fatigue properties. No perceptible difference was observed between the endurance limits of wire from corresponding reels hot-galvanized with 4 and 3½ dip coatings. Reduction by drafting, within the range investigated, increased the fatigue resistance of the wires both in the lead-annealed and zinc-coated conditions. Hot-dip zinc coatings developed, under reversed stressing, closely spaced hair cracks perpendicular to and terminating at the surface of the steel. In electro-deposited zinc coatings no evidences of such cracks could be found after similar treatment. The results obtained on defective wires, containing surface seams or non-metallic inclusions, demonstrated the utility of the fatigue test for detecting faulty material. No definite correlation could be observed between the data furnished by the ordinary bend and the twist tests, as carried out at the mill, and the endurance limits of the wires.

There were two papers by Dr. J. N. Kenyon, Columbia University, in this session—one describing a pulsating tension-fatigue machine for small diameter wire, of unique construction and application. It involves three reciprocating forces, 120-deg. out of phase, which exert a constant torque on the motor and thus eliminates unbalanced inertial effects. The machine is especially adapted for testing used wire in order to determine the extent of deterioration in endurance properties. His other paper discussed a corrosion-fatigue test to determine the protective qualities of metallic platings.

It was shown that the measurements obtained by static corrosion and static physical tests, hitherto relied upon to determine the probable service qualities of bead wire, are inadequate for classifying these materials. Only fatigue tests wherein there is simultaneous corrosive attack, are sufficiently discriminatory for determining relative service qualities.

It was found that plating with a more noble metal, such as copper, may actually contribute to the embrittlement of steel wire by reason of numerous fatigue cracks resulting from galvanic action at points of imperfection in the plating. No embrittling conditions were encountered where the wire had first been galvanized before plating with copper.

Purification of Nickel and Copper Plating Solutions

Q. I have just received the 1940 Plating & Finishing Guidebook, and was very much interested in reading the notes in it on filtering and purifying plating solutions.

I am particularly interested in the purification of acid copper and notice that to remove organic impurities, the use of potassium permanganate is mentioned, and it also mentions that the solution is heated until the permanganate color disappears.

I am wondering whether this has to be heated or whether the effect will be accomplished, even if slower, without raising the temperature above the normal operating temperature.

I notice under nickel solutions the same treatment is mentioned, except it states the solution is allowed to stand until the purple color disappears, and in parenthesis it says "preferably warm".

To sum this up, it is a little inconvenient for us to warm our solution, and I would like to have your opinion as to whether this treatment can be carried with our solution at the normal temperature of 77° F.

A. The purification of acid copper plating solutions through the use of potassium permanganate can be carried out at ordinary temperatures, but it will take a much longer time for the reaction to complete itself and for the permanganate color to disappear. If the treatment is to be carried out at the ordinary temperature, it would be desirable to leave the solution standing over a week-end after the permanganate has been added in order to interfere as little as possible with production.—L. W.

Low Efficiency Copper Solution

Q. Under separate cover, we are sending you samples of our copper cyanide solutions for analysis, old solution and new solution.

We have been having considerable trouble and decided to make an entirely new solution which we did according to the formula in the Plating & Finishing Guidebook. This solution works fine for a day and then seems to lose all its throwing power.

This solution is contained in an iron tank, the sides of which close to the

Technical Advisors For August Issue

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Consultant in Electroplating,
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anodes become copper coated. Would this coating be the cause of the solution becoming weaker. We have tried putting glass between the anodes and tank, which did not seem to make much difference in the life power of the solution.

Our production consists of plating the regular lead-antimony alloy. We give it a flash in cyanide copper, and then a fairly heavy plate in the acid copper.

Our set-up is such that we must have an extremely fast cyanide copper for our flash plate. The first day the solution was in operation it worked satisfactorily. The second day we had to leave the work in twice as long before it would even begin to plate. We do not feel that we have done enough work the first day to entirely deplete the solution, although this might be the case since the tank only holds 50 gallons.

Analyses of new and old copper solutions are:

	No. 1	No. 2
Copper	9.3	2.5 ozs./gal.
Free cyanide	1.45	0.45 "

It is believed that your trouble is due to the low cyanide content. Add 1/2 oz./gal. of sodium cyanide to the No. 2 solution, which is assumed to be the solution with which you are having trouble.

What is probably happening is that under the flash plating conditions you are using a high tank voltage. The high current which flows causes the anodes

to polarize especially with the low free cyanide. You are plating so fast that you are decomposing the free cyanide rapidly. When the anodes become polarized, current ceases to flow, even though you impress the same tank voltage. This point can be checked by installing an ammeter on the tank.

To reduce the anode polarization, add cyanide as suggested above. High free cyanide will also cause low efficiency. Also increase the anode area.

The rapid decomposition of cyanide may be caused by operating the solution too hot. Keep the temperature below 150 deg. F.

The metal content of No. 2 solution is all right. The metal content of No. 1 solution, is much too high for flash plating work.—G. B. H., Jr.

Burnishing Jewelry

Q. We would appreciate having you advise us of the method used in dry burnishing cheap jewelry, and also the type of barrel and equipment used.

A. Dry burnishing of cheap jewelry is not the customary method used by the average manufacturers of that class of work. The dry process requires more time than the wet burnishing method.

It can, however, be done successfully and satisfactorily depending upon the base metal used. Iron or steel articles are more suited to dry burnishing than are brass and other non-ferrous metals.

The operation of dry burnishing is carried out in oblique (tilted) iron or hardwood, round or octagonal barrels. The type of work lends consideration to various factors involved; such as, abrasives, polishing medium, kind of barrel and rotation to be used. Leather meal (shoemaker's scraps), steel balls, hardwood sawdust, cork, maplewood balls, corn meal, rouge or a mixture of two or more of the above are the materials that are used along with the work. The speed of the barrel would vary depending on the load and type barrel. 10 to 30 R.P.M. are employed. Cleanliness of the work and the polishing material are very essential.

More satisfactory results would be obtained in your case, using the wet method of water, neutral soap or commercial burnishing compounds along with steel balls, cones, discs, slugs, etc.

Suggest that you consult manufacturers of burnishing equipment advertised in METAL FINISHING for your specific requirements.—P.A.O.

ELECTROPLATING DIGEST

SELECTED ABSTRACTS ON PLATING—FINISHING—RUST PROOFING—LACQUERING

Electrodeposition of Copper

U. S. Patent 2,195,454, Lawrence Green-span, New York, assignor to Louis Weisberg, Inc., New York, April 2, 1940. This invention relates to methods for producing lustrous and ductile electrodeposits of copper. Complex amine baths are used and the preferred amine is diethylene triamine. However, copper complexes with diethylene triamine do not give satisfactory deposits, and it was found that excellent bright ductile coatings can be produced from copper complex amine deposits to which ammonia and/or ammonium salts were added. A wetting agent is also recommended to reduce pitting. A typical solution is as follows:

Copper sulfate	100 g/l
Diethylene triamine ..	80 c.c. per liter
Ammonium sulfate ...	20 g/l

The patented solution is said to give uniform bright deposits over a wide current density range with current efficiencies better than 90%. Electrolytic copper anodes were found to dissolve more rapidly and smoothly in these solutions than ordinary copper.

Treatment of Stainless Steel

U. S. Patent 2,174,516, H. O. Kauffmann and R. L. McEwen, assignors to Buffalo Electrochemical Co., October 3, 1939. Passivating stainless steel before exposure to active chlorine and hypochlorites by a persulfate treatment. Ex: immerse for 8-48 hours at room temperature or for 6 hours or more at 55°-90° C. in potassium persulfate—1.2 g/l.

Protection of Hot Dipped Coatings

U. S. Patent 2,176,066, E. C. Domm, assignor to National Standard Co., October 17, 1939. Process of increasing the corrosion resistance of a hot dipped coating by tin plating. Patent also claims a ferrous base with a hot dipped coating predominantly lead with 2.5%-30% antimony (preferably 5%) and subsequently electroplated with tin to a thickness of 0.0001 to 0.0002 inches.

Metal Coating Process

U. S. Patent No. 2,195,499, J. K. Schofield, April 2, 1940. A process comprising electroplating iron and steel with copper and then with chromium and afterward heating in a non-oxidizing atmosphere for a short time at the melting point of the copper to allow the copper to fuse and form a bond.

Acid Pickling Inhibitor

U. S. Patent No. 2,201,488, M. H. Harman, assignor to Monsanto Chemical Co. May 1, 1940. A thiourethane compound such as N-phenyl butyl thiourethane or N-phenyl benzyl thiourethane. For example:

750 cc. of 6% by weight sulfuric acid solution
0.0936 grams of inhibitor

Electrogalvanizing

U. S. Patent No. 2,200,987, J. P. Hubbell & L. Weisberg, May 14, 1940. A solution containing zinc and an excess of ammonium hydroxide over that required to form the zinc tetrammine compound, using high current densities. The solution should contain at least 80 g/l zinc and 8 g/l free ammonia with a current density of 500-1,000 amps./sq. ft. Strong agitation is required. The solution is produced by leaching the ore with ammonia and an inorganic ammonia salt until at least 100 g/l of zinc is dissolved and treating to remove iron and dirt. The solution also contains more than enough chloride to form zinc tetrammine chloride— $Zn(NH_3)_4Cl_2$. Sal skimmings from hot galvanizing plants may be used. For plating, carbon or graphite anodes are used, or if no chloride is present, iron or stainless steel. The temperature is not critical, 30° C. being very satisfactory and high temperatures resulting in loss of the free ammonia. A wetting agent may be added to prevent sponginess. Example: Leach sal skimmings until composition of the electrolyte is:

Zinc	104 g/l
Chloride	159 "
Total ammonia	164.2 "

including:

Ammonia combined as zinc tetrammine salt ..	108 g/l
Ammonia combined as ammonium chloride	22 "
Free ammonia	34 "

Add a small amount of hydrogen peroxide to precipitate the iron and filter. No other purification is necessary. Speed of 12 gauge wire is 120 ft. per minute—no other agitation necessary.

Detinning

U. S. Patent No. 2,200,782, A. Vollmer, assignor to Metal and Thermit Corp. May 14, 1940. A process of detinning in which the tin coating is removed by immersion in a solution of sodium metanitrobenzoate or other nitro substituted organic compound of the benzene series which is stable toward anodic oxidation

and caustic soda, the concentration being about 4-9% and the temperature from 60° C. to boiling. The dissolved tin is at the same time removed by plating out in a coherent form on suitable cathodes at 2.5-3 volts, at a current density up to 300 amps./sq. meter with efficiency of 90-99% if the bath is kept saturated with tin. Example:

Metanitrobenzoic acid	50 pts. by weight
Caustic soda	75 " " "
Water	1,375 " " "

Iron tank is used as anode. Temp. 75° C. Solution is agitated and the current density is kept below 3 amps./sq. dm.

Greaseless Buffing Compound

U. S. Patent No. 2,200,726, E. E. Seeley, May 14, 1940. A compound comprising a resinous, alcohol soluble lac of the order of shellac, a relatively non-aqueous solvent therefor, a resin which is oil soluble and a major percentage of abrasive material. For example:

Shellac	9%
Rosin	3%
Diethylene glycol	6%
Abrasive	82%
(200 mesh silica, for example)	

The shellac and rosin are first dissolved in the glycol compound preferably at 180° F. and the abrasive is then stirred in.

Acid Proof and Waterproof Cement

U. S. Patent No. 2,195,586, Foster Dee Snell, April 2, 1940. A neutral silicate cement comprising the reaction products of 9.4 parts of solid sodium silicofluoride and 70 parts of liquid 38% sodium silicate of ratio $Na_2O:SiO_2 = 1:3.25$ plus a suitable amount of aggregate. At least enough silicofluoride must be present to neutralize the silicate. An equivalent amount of solid sodium bifluoride may be substituted for the silicofluoride.

Insoluble Anode for Sulfate Solutions

U. S. Patent No. 2,198,045, R. Suchy & G. Messner, assignors to I. G. Farbenindustrie, A.G., Germany, April 23, 1940. An anode containing lead and silver in which the silver is present between 2.5% and 7.5% by weight or an anode containing 96% lead, 3% silver and 1% arsenic. If such an anode is used in a sulfate solution at a temperature below 50° C., the formation of lead peroxide is claimed to be completely suppressed.

Post Scripts

Gleanings from Dayton

Floyd Oplinger (DuPont) and Bert Lewis (Northwest Chemical Co.) were not in agreement concerning electro-cleaning of zinc. Floyd advocated cathodic cleaning and Lewis, anodic cleaning. They both agreed overcleaning was contributory to blistering of deposits.

We had just finished listening to Dick Hull's ingenious study of zinc anodes when Bob Green (Alsop) said, "Let's go swimming, there's a pool only a mile away." Yes, the water was fine.

Dr. Henry Kellner (Lea) told us an interesting story about Walter Helbig. Helbig was in a room looking at an exhibit of wooden plating cylinders. The conversation went something like this:

Helbig: "Will these barrels stand up in alkaline solutions?"

Attendant: "They certainly will."

Helbig: "I thought cellulose was attacked by alkalis?"

Attendant: "There's no cellulose in these barrels. They are made of nothing but pure second growth white oak."

It is like the attendant at the Cadillac exhibit of the 1939 Auto Show in New York. He was asked whether the finishes on the cars were synthetic enamels and replied indignantly, "There's nothing synthetic about these cars. They are high-class".

In case anyone is interested, the three tallest men at the convention were: John P. Clarner, 6'4½"; Colgate Gilbert 6'4", and John MacLean, 6'3".

The business sessions were rather tame, no fights.

Ray and Mrs. Goodsell had a hard time Monday night at the party with an inebriate who insisted on using their seats, due fundamentally, to poor power of locomotion.

Jim Bell from Nashville, Tenn., was observed comparing corporations with Horace Smith. Jim won by two inches.

The Egyptian Lacquer Mfg. Co. crowd were quite the dandies, in their brick-colored shirts: Ben Popper, Charlie Schlott, George Morrow, Art Snow, Aaron Sopher, Paul Bloom, Jack Malool and Grayle Howlett.

Carl Heussner (Chrysler Corp.) certainly knows his parliamentary law. He

made sure the business meetings were run according to Hoyle or Roberts.

Riding back from the picnic, we overheard Fred Norgren (F. B. Stevens, Inc.) tell the following story: It happened in a theatre after an act on the stage had used incense which filled the place with its odor. A man entered and was led down the aisle by an usher, the man sniffing meanwhile, said: "I smell punk".

The usher paid no heed and after the man sniffed a little more, said again:

"I smell punk".

To which the usher replied:

"Oh, that's all right, we'll put you where you won't bother anybody".

William Belke was taken to the hospital on Tuesday, the week of the convention, and left for home on Friday. Latest reports are that he is doing fine.

Farber, Paul Strausser, Dr. Richard Wick, Thomas Slattery, Richard Dimon and Richard Hull. They are making their mark in industry being employed respectively with Westinghouse, Frederic B. Stevens, Inc., Bethlehem Steel Corp., Bureau of Engraving & Printing, Carnegie-Illinois Steel Co., and the DuPont Company.

Fred Gumm recently became a grandpappy, when wife of son John, gave birth to a girl.

Enter Ed Rinker (Oakite) and Frank Watt (F. B. Stevens) in the new papa column. It was No. 1 for Ed, and No. 2 for Frank.

Walter Barrows, beloved A.E.S. old-timer from Toronto, informed us that he was brought home June 16th, after being in the hospital since October 24, 1939.



Wives of some A.E.S. men. Left to right, Mrs. Ruth George, Mrs. Arthur Logozzo, Mrs. Helen Henry, Mrs. Laura MacDermid, Mrs. Bert Sage, Mrs. Burt Daw, don't know, Philip Prouty and Doug MacDermid in rear.

The nicest prize given away at the banquet by the Hanson-Van Winkle-Munning Company, was a set of silverware. Mrs. Pauline Sterling, wife of G.E.'s Joe Sterling, had the lucky number called by Lou Hague.

A luncheon meeting was held by the past research associates at the Bureau of Standards who worked with Dr. Blum. The past associates present were: Harold

The good wishes of all go to you, Walter Barrows.

East-West Baseball Game

The East met the West in spite of the old adage about the twain never meeting and when the battle was over the Eastern Blitzkrieg had completely annihilated the boys from the Automobile States.

Senior Logozzo, All-Eastern Pitcher for

the complete game, just played catch with back stop *Romano*. The boys from "out yonder" just could not see the brilliant nickel plated ball. Incidentally, the score was East 15, West 5.

It must be stated, however, that the cowboys never let up in their efforts. They were in there from the start through the finish. Namely, among those working hard was Colonel *Savage*. Some mighty blasts gave he with his vocal cords, but more than a tuba was required to help him against the East. Captain *Leonard Weeg* from Peru, Ill. also did some pretty maneuvering, especially from the point of view of shifting the batting line up.

Short-stop *Young* became "stop-short" *Young* when he fanned the last time at bat. In all reality, the ball was not even seen because he was not even looking. Better wake up. And what was that crack *Logozzo* made about *Young's* hair looking like an octopus anode. A fair comparison we would say.

Ray Goodsell received the battered suicide cup for his invaluable services as official umpire. Any man who will stick out his neck to officiate at such a game should get a gold cup. *Ray*, we are proud of you because of the courage. It might be mentioned that there were two dishonorable assistants, one of them comes from "Joisey". The other has been in the Society a long time. And are they blind????

Anyway, the East says next year will show this was only a preliminary effort in throwing power and batting efficiency. The West says that revenge is theirs. Watch out Boston! . . .

Respectfully yours,
Capt. Young

+

Burglars recently broke into the office of *M. D. Rynkofs' Liberty Plating Co.*, 525 North LaBrea Ave., Los Angeles, and stole \$110 in cash and three ounces of gold.

To add insult to injury, the crooks used tools from *Mr. Rynkofs' own shop* to break open a desk which contained the "loot."

+

E. W. Francis watched the installation of *Don Bedwell* as president of Los Angeles Chapter with an "I knew him when" look in his eyes.

Their acquaintance dates back more than three decades. *Mr. Francis* recalled when the brothers *Don* and *Gene Bedwell* operated a plating shop on Flower St., Los Angeles, in 1908, and that *Don* worked for him as a plater in 1909 when *Francis* was shop superintendent for the *W. S. Hutchison Fixture Co.* of Los Angeles.

"And he was a darn good plater, too," was *Francis' tribute*.

Mr. Francis today operates the Electro-Plating Shop, 3431 South Main St., Los Angeles. *Mr. Bedwell* is associated with the firm of *Hallenscheid and McDonald*, 1344 W. Washington Blvd.



Ye Editor (with glasses), with Ed Charleson (left) and Joe Sterling (right), as Joe claims he saw it.

+

The Mystery of the Beard

Dear Walter:

I saw a photograph of you with Ed Charleson and myself in a small, contemporary publication. As I remember you at that time when the picture was taken at *Frederic B. Stevens' Open House*, you had no moustache and were beardless, and I am sure I was sober at the time. How you accomplished the moustache and beard after the photograph was taken, is beyond me, but with that outfit you could pass as minister of something—or—other in one of the foreign countries. If you are planning on diplomatic service in some of these countries, that picture of yours ought to put you in the inner sanctum, but to me, I would rather have you as you always have been and don't let anyone raise any more moustaches and beards for you.

Sincerely yours,
Joseph G. Sterling

+

John L. Merigold and *Bruno H. Schindler* of Los Angeles Chapter talking over old-time electroplating practices:

"I remember the time in the old country," reminisced *Bruno*, "when they used pigs' bladders for burnishing with the grease in the bladder acting as greaser, and when stale beer was used for scratch brushing."

"Huh!" chuckled an onlooker. "That's out today. Nowadays you couldn't use stale beer for brushing. No beer would stay around a plating shop long enough to get stale."

+

Wilfred S. McKeon, President of *Sulphur Products Co., Inc.*, Greensburg, Pa., returned July 19 on the *S.S. Kungsholm*.



The same Joe Sterling and Ed Charleson with the Editor transformed into an ambassador from Balalaika.

+

Mac visited Haiti and Cuba, and made a trip into the heart of the jungle of Haiti, to visit the ruins of *Fort-Castle*, built there almost two centuries ago by *King Christophe* of "Black Majesty" fame.

+

Why Play Football When You Can Ride on the Subway

5:30 P.M. has arrived. It's the time for the mad scramble to the subway. Woe betide anyone who stands in front of the turnstiles looking for a nickel. It's hot, humid, dirty and noisy. The subway roars into the station. It's so crowded already that they're jammed to the doors, which suddenly open. A wild look appears in the eyes of the offensive side (they are the people trying to get on) and an equally wild look is noticed in the eyes of the defensive side (they're the people trying to stay in without being crushed).

With an oldtime flying wedge, the irresistible meets the immovable force and this time the irresistible force wins. The old axiom of nature "two things cannot occupy the same space at the same time" is shattered. It's so crowded that your arms are pinned to your sides. There's no fear of falling when the car lurches. You can't fall—you are stacked far worse than any sardine. Your nose itches—well let it itch—you can't scratch it.

The subway reaches your destination—the offensive and defensive roles are complicated. You try to force your way out and are met by another wild-eyed crowd and if you are lucky you get off—if not, you ride along a couple of more stations. It sounds awful but they really get used to it.

Walter R Meyer

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

New Aluminum Cleaner

A new aluminum cleaner, called Cowles AE, for general cleaning of aluminum parts of all kinds has been added to the line of metal cleaners manufactured by the Cowles Detergent Company, 7016 Euclid Avenue, Cleveland, Ohio. This mildly alkaline cleaner has been especially designed to prevent corrosion of non-ferrous metals when cleaned. Mirror-finished surfaces of aluminum are not visibly affected by a one hour exposure to concentrations of this cleaner as high as six ounces per gallon at boiling. The cleaner is claimed to have been compounded to produce in solution the high colloidal activity and proper balance of detergent anions necessary for the efficient and safe cleaning of aluminum parts from accumulations of shop dirt, drawing and cutting oils. It is customarily used in concentrations of three to six ounces per gallon of hot water. The time of immersion and temperature of the solutions are dependent upon the individual cleaning demand. Parts cleaned rinse freely and after drying are ready for further finishing, assembly or shipment.

New Air Grinders

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., have announced a new portable air grinder. The "Air Behind the Blades" principle is said to keep the rotor blades of the grinder out against the cylinder wall, preventing any "dead center" position or the depression of the blades in the slots due to oil accumulation. As a result, positive starting is assured under all operating conditions.

The company manufactures a complete range of grinders, including 50 models and sizes for every type of grinding from snagging rough castings to finishing precision dies.



Portable air grinder.

Centriforce Washer

A new centrifugal which washes, rinses and dries small metal parts—all in one machine—has just been announced by Tolhurst Centrifugal Division, American Machine and Metals, Inc. Designed for use in machine shops and plating plants, the new centrifugal is called the "Centriforce" Washer. As a detergent washer, the machine washes screw machine parts with hot detergent solution to remove oil, grease, dirt or fine chips. As a rinser, the work is spun in the centrifugal while a spray of hot water swirls through the



Centrifugal machine which washes, rinses and dries small metal parts.

parts. As a dryer (use of sawdust is eliminated), the machine is revolved at high speeds while blasts of hot air are forced through and around the parts. Up to 25 batches an hour are handled in the "Centriforce". Descriptive bulletin can be obtained by writing Tolhurst Centrifugal Division, East Moline, Illinois.

Black Finish on Steel

An improvement has recently been announced in the Jetal process for applying a black corrosion resistant finish to steel. The process has been changed to a two-bath system which yields a deeper black coating and at the same time, simpler manipulation and control of the solution.

Two tanks of ordinary iron or steel are required for the process. (No brass or copper fittings should be used.) The first, or "A" tank, should be kept at 280°-290° F., and the second, at 305°-315° F.

Three water-rinsing operations are in-

volved, which may be carried out in one or more steel tanks. The water containing the drag-out should be used to replace evaporation losses from both Jetal tanks, but the iron in this drag-out water must be removed before it is returned to the system, either by filtration or by allowing the iron precipitate to settle and siphoning off the clear water. It is customary to use a final hot rinse to speed up the drying operation, but drying in warm air is also practicable.

All steels, except those high in nickel or chromium, can be colored black by the process. (Cast iron and some special steels may require deviations from the routine process.) The first step is to remove excess grease or oil from the work in a suitable cleaning solution. Then, dip the work in the alkaline rinse water containing the drag-out. In many cases, such as with hardened steel surfaces, it is advisable to give the cleaned work a short dip in cold dilute acid to secure a deeper black in a shorter time. Heavy scale or rust should be removed in a pickle. The acid dip must be followed with a water rinse before placing the work in the drag-out rinse. From the drag-out rinse, the wet work is placed immediately in the Jetal "A" tank and kept there until some coloration is noted. The work is then removed, rinsed in

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CUT COSTS, BUILD PROFITS

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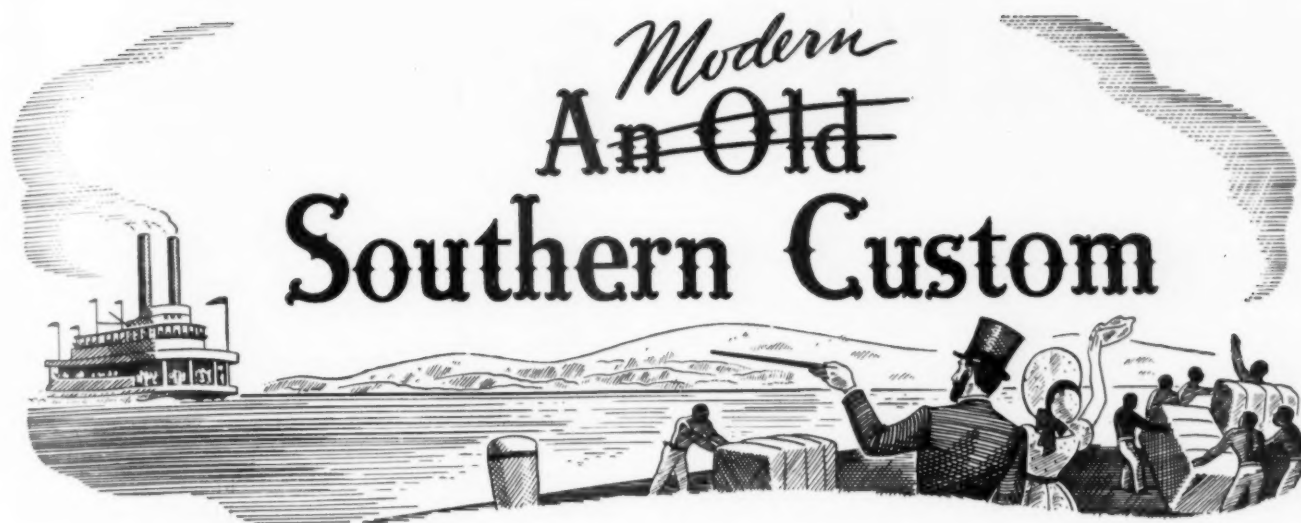
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Any plating solution analyzed for \$1.
Reagent solutions for analyzing 50c. qt.

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1153 St. George Ave., Roselle, N. J.

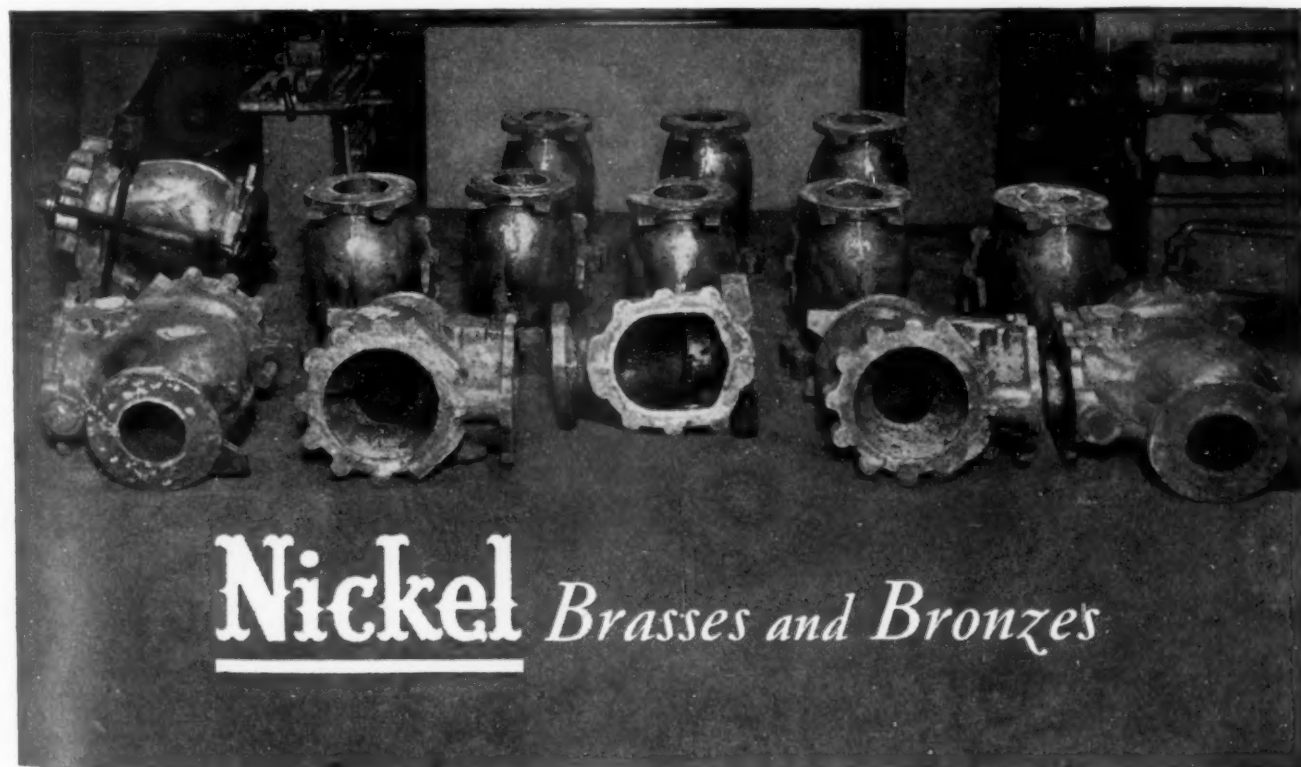


Nowadays progressive foundrymen rely upon Nickel to minimize shrinkage porosity and refine the grain of castings which must be pressure tight. Down in New Orleans, the F. H. Koretke Brass and Mfg. Co., cast these 6" water meter valves to withstand 225 lbs. pressure per square inch. Koretke uses an 88-10-2 "G" bronze mixture, modified by 1½% Nickel.

- By replacing 3½% tin in this bronze composition with an equal amount of Nickel, similar castings will withstand more than 3,000 lbs. pressure per square

inch. • The practical observation of many foundrymen has firmly established the fact that Nickel improves metal fluidity which aids in filling all parts of the mold and reduces rejections. By promoting a dense close-grained structure, Nickel assures pressure tightness of brass and bronze castings. • Improved pressure-tightness is but one of many money saving advantages Nickel offers you men who cast and use brass and bronze. Please write for more detailed information about money-saving applications of Nickel.

Water meter valve bodies weighing 275 lbs. each, cast by the F. H. Koretke Brass & Mfg. Co., New Orleans. Their "G" bronze composition was alloyed with 1½% Nickel.



THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.
METAL FINISHING, August, 1940

PLATERS

Reduce Rejects—Save Money

IN CHROMIUM and nickel plating, for instance, high dependable performance has earned for Metso Cleaners top preference. Their thorough cleansing action removes drawing or stamping oils and other dirt from the metal surface or any *entrapped* in crevices.

Cleaned pieces show no water break and can receive direct chromium or nickel plate that stands the severest adherence test.

Put a Metso Cleaner to work in your plating department, for better results at a saving. Metso Cleaners are basic alkalis, sold at basic alkali prices, thereby effecting lower costs over a period of a year. Write Dept. FS.

Metso Cleaners Manufactured Exclusively by

PHILADELPHIA QUARTZ CO.

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Chicago Sales Office: 205 W. Wacker Drive, Metso stocks in 60 cities.
Sold in Canada by NATIONAL SILICATES LTD., Toronto, Ontario



**METSO
CLEANERS**

cold water and immediately placed in the Jetal "B" solution where it remains until the desired depth of black is obtained. This operation is followed by a rinse in the cold drag-out tank, and then with another cold rinse, and finally the hot rinse, to remove the final traces of the Jetal solution. The last rinse may be in hot water alone or in hot water containing 6% or more of a suitable soluble oil in order to obtain dry finished work of excellent appearance.

The time required for the Jetal dips varies with the class of work, but in general, ranges from about 2 minutes to 5 minutes in each tank.

Full details of the operating methods, manipulation and control of solution, etc., are obtainable from the Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies.

Foot Operated Welder

The Acme Electric Welder Company of Huntington Park, California announces a new improved line of foot operated rocker arm type spot welders with all welded fabricated steel bases and incorporating a great many innovations and distinctive features.

The type O with stationary lower horn holder and the Type 1 with swivel lower horn holder are manufactured in 10, 15 and 20 KVA capacities and in throat lengths of from 12" to 36", complete with water cooling equipment.

A clamping block device retains the horns in the horn holders with ideal electrical contact, yet a half turn of a $\frac{5}{8}$ " diameter set screw instantly releases for change of set up.

Horns are universal double and reversible, one end machined to hold elec-



Foot-operated, rocker-arm type spot welder.

trodes at 90 degree angle and opposite end 22½ degree angle.

Complete details of Type O and Type 1 spot welders are described in new Bulletin No. 50 which will be gladly sent on request. Other spot welders in the line include foot operated machines up to 75 KVA and automatic air operated production machines up to 500 KVA.

Sweat Bands

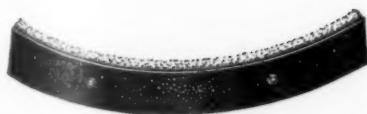
Two new, ruggedly constructed sweat bands, made of fine pore, cellulose sponge securely stitched to a fabricoid band with an inner lining of cork, are announced by the Jackson Electrode Holder Co., Detroit, Mich.

No. 15, photographed in position, is a general purpose band—reported to be a perfect safety device for eliminating the hazard of perspiration running into the eyes. It is easily adjusted to the head with a long-lasting, $\frac{1}{2}$ " wide, elastic band.

No. 5, illustrated in the drawing, is intended for use with all Jackson eye-shields except Types D, D-6 and No. 25. It is easily snapped inside the bands. Both bands are said to be light, cool, comfortable—easily absorb more than fifteen times their weight in moisture. Both are sanitary, as they are quickly cleaned by letting water or any safe antiseptic solution run through the sponge cellulose.



Illustration of sweat band in position.



Drawing of sweat band to be used with the company's eye shields.

Manufacturers' Literature

Adhesive. Bulletin 107 of the J. J. Siefen Co., 5657 Lauderdale St., Detroit, Mich., describes various uses for their liquid glue called "Nuglu". These uses include setting up of all kinds of polishing wheels, making belt polishes, abrasive discs, coated steel discs, repairing objects and various other adhesive purposes.

Ammonia Mask. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa., in a 4-page illustrated folder describe their new ammonia mask. The company's All-Vision facepiece has been added to the mask as standard equipment.

Brazing Alloys. Handy and Harman, 82 Fulton St., N. Y., describe and illustrate uses for their brazing alloys called, "Sil-Fos" and "Easy-Flo". The former is an alloy of low silver content which melts at 1300° F., and is intended for joining copper, brass, bronze and other non-ferrous metals. The latter alloy has a lower flow, namely, 1175° F., and is recommended for joining either ferrous or non-ferrous metals.

Chemicals. Prices for R & H Chemicals of E. I. duPont de Nemours & Co., Wilmington, Del., are given in their July 1940 quarterly price list.

Detergent. Michel Export Co., 90 Broad St., N. Y. C., in a recent booklet describe "Alframine DCA", a soapless soap. It is said to possess all of the advantages of soap without soap's disadvantages, such as lack of resistance to acid, lime, etc. The detergent withstands both acid and alkaline solutions, and is recommended to various industries, such as the textile, leather, paper and metal finishing.

Filters. American Seitz Filter Corp., Paterson, N. J., describe and illustrate their sheet filters in a new 12-page booklet. The various operating features of the filters, such as double filtration and 100% sterilization, high yields at low pressures, are explained. Copy will be mailed to any reader, on request.

Gold Plating. Baker & Co., Inc., 113 Astor St., Newark, N. J., have just published a booklet entitled "The Baker Guide to Successful Plating with Gold", which gives much valuable information pertaining to gold plating. The book discusses the compositions of various salts used in plating, equipment necessary,

Regular Type



Type "A"

Type "K"

A new user of Bias Buffs writes us—

"We received the 6 sections of Bias Buffs which you sent us for a trial, and we thank you for giving us the opportunity to find out how good they are."

"We placed these buffs to work immediately and they have done everything you claim they will do. It appears as though our polishers would not be satisfied to go back to the old ones we have been using."

It is unnecessary for us to say more—but would you like to try BIAS Buffs? Write us.

The BIAS BUFF and WHEEL CO., Inc.
430 Communipaw Ave.
Jersey City, N. J.

preparation of work and various gold plating solutions, including the chloride and cyanide baths. Various hints and formulae for producing colored gold deposits are given.

Gold Plating. A Robinson & Son, 131 Canal St., N. Y. City, in a recent release entitled, "The Story of a Valuable Contribution to the Art of Gold Plating", discuss the status of gold plating, the disadvantages of the plater preparing his own solution, and the advantages of using standardized, prepared gold plating solutions.

Rubber Coated Products. Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich., have released two bulletins describing various rubber coated products as supplied by the company. Included

among the products described are dipping baskets, acid pitchers and dippers, anode savers, tanks and crocks.

Soldering Aluminum. Lloyd S. Johnson Co., 2241 Indiana Ave., Chicago, Ill., describe and illustrate the Alumaweld solder and flux for soldering aluminum, magnesium, cast iron and other alloys. The flux can be had in both powder and liquid forms. Various applications for the flux and solder are illustrated.

Spot Welders. Bulletin No. 50 of the Acme Electric Welder Co., Huntington Park, Calif., describes the company's Types O and I foot operated spot welders. Illustrations and specifications for these welders are given as well as for the welding electrodes and devices to be used with the welders.

STAINLESS STEEL POLISHING COMPOUNDS

Are Proven Every Day in Every
Kind of a Metal Working Plant



"4-A" Polishing Compounds Are Faster, More Efficient, More Economical for Polishing, Mirror Finishing of All Kinds of Steel, Including Stainless Steel and Other Alloys.

Use it on any kind of a wheel, soft, hard, medium. Results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem. No obligation, of course.

CEMENT AND THINNER

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc.

Samples of Compound or Cement sent on request.

HARRISON & COMPANY

HAVERHILL, MASS.

Temperature Regulators. Sarco Co., Inc., 183 Madison Ave., New York, announce the issue of their new catalog, No. 52, covering self-operated temperature regulators for controlling flow of steam, gas, water or brine. Sixteen pages, profusely illustrated, show several new types recently added. A special feature is complete capacity tables for several different valve styles to meet control problems in connection with industrial process work, water heating, air conditioning, refrigeration, etc.

New Books

Handbook of Procedure and Practices under the National Labor Relations Act. By W. A. Rinckhoff and Harvey B. Rector. Size 8½" x 5½"; 126 pages. Pub-

lished by Law Research Service, New York. Price \$7.50 with supplementary service. Additional copies for the use of foremen and supervision are quoted at \$3.50 each.

The intention of this book is to give correct interpretation of the National Labor Relations Act, to enable the protection of the constitutional rights of employers of labor against wrongful charges of labor unions. The information contained is based upon actual experiences with labor organizations and the National Labor Relations Board.

Error Corrected in the Book, "Engineering Alloys", by N. E. Woldman and A. J. Dornblatt. Published by American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio. It has been announced by the publishers that the American Manganese Bronze Co., Holmesburg, Philadelphia, Pa., listed in the book in section 4 entitled, "Manufacturers and Their Al-

loys" on page 508, is not out of business as listed, and are carrying on their activities as usual.

In Section 1, under the alphabetical listing of their alloys, on page 117, Hyten-sl Bronze was marked "obsolete". This is incorrect. Hyten-sl is still being made in all grades.

On page 134 Resistac and on page 233 Everbrite, were marked "obsolete". This is incorrect. These are not obsolete.

The publishers regret this error and therefore send this notice to all purchasers of this book.

Phenomena at the Temperature of Liquid Helium. An American Chemical Society Monograph. By E. F. Burton, H. Grayson Smith and J. O. Wilhelm. Size 9" x 6"; 352 pages. Published by Reinhold Publishing Corp., New York. Price \$6.00.

The book contains an historical introduction to the subject which is followed by the following chapters: The Liquefaction of Gases; The Measurement of Temperature; The Physical Properties of Liquid and Solid Helium; Superconductivity; Specific Heats at Low Temperatures; Magnetic Properties; Temperatures Below 1° K; Electrical and Thermal Conductivities; The Nature of the Superconducting State; The Transformation in Liquid Helium and the Nature of Helium II.

An Outline of Metallurgical Practice. By Carle R. Hayward. Size 9¼" x 6¼"; 669 pages. Published by D. Van Nostrand Co., New York. Price \$7.50. Second edition.

This second edition of the well known book by Prof. Hayward represents a rather complete revision of the first edition. It describes new processes developed and improvements in old processes which have taken place since the publication of the first edition in 1929.

Chapters on zirconium and beryllium have been added and the chapter on non-ferrous alloys has been slightly enlarged and the equilibrium diagrams brought up to date.

The book is designed to meet the desire of engineers as a quick reference book and to assist students who are starting their metallurgical studies, with no practical experience.

Unfortunately, the short references to nickel and chromium plating are both inaccurate and out of date, and evidently the discussion on plating was not thoroughly revised. One statement is particularly inaccurate, namely, that in operating nickel plating solutions, the current usually starts at 12 to 14 amperes per sq. ft., and is then diminished to 2 to 4 amperes per sq. ft., to assure a smooth solid deposit. The nickel solutions given do not represent modern practice. Ambiguous statements are also made in regard to chromium plating, particularly in regard to its corrosion imparting resistance and that chromium makes a satisfactory coating on brass and copper.

Metallurgical Abstracts (General and Non-Ferrous). Edited by S. C. Guillian. Volume 6 (New Series), 1939. Demy 8 vo. Size 8½" x 5½"; 683 pages. 1940. London: The Institute of Metals, 4 Grosvenor Gardens, London, S.W. 1. Subscription price, including two bound volumes of the Journal of the Institute of Metals, price £4, post free.

The present volume consists of the twelve issues for 1939 furnished with the name index, and a detailed subject index to facilitate easy reference. Every effort is being made to maintain these abstracts during the war, at the usual high standards.

Manufacturers' Product, Package and Price Policies. By Albert Wesley Frey. Size 8½" x 6"; 420 pages. Published by the Ronald Press Co., New York. Price \$4.50.

A valuable book for those engaged in marketing goods. This book describes and analyzes policies and practices which manufacturers have developed in their solution of vital product, price and package problems.

The book is written in the hope of filling a need felt by the executive who wishes to review and check his own merchandise, organization, policies and procedures, or by the executive who is faced with specific problems of a merchandising nature.

Letters From Our Readers

On Nickel Itch

Hogan Plating Shop,
Baton Rouge, La.

July 17, 1940.

METAL FINISHING,
New York.
Gentlemen:

We note an inquiry in your July issue pertaining to cyanide sores.

The following may be of interest to the inquirer.

Salve for Nickel Platers' Itch

This annoying malady is caused mainly by uncleanness and is very irritating especially if allowed to continue for some time without some form of treatment. As the first requisite is cleanliness, it is advisable to bathe the body freely and also to take some form of cathartic. A tablespoon of Rochelle salts dissolved in a glass of warm water, taken each morning before breakfast, is beneficial.

The afflicted parts of the body should receive the following treatment:

Formula No. 1

Sodium bicarbonate	4 ozs.
Potassium chlorate	2 "
Sodium borate	2 "



ANOTHER CUT IN CLEANING COSTS

● It's getting to be almost as regular as the action of a well-oiled buzz-saw—this cutting of metal pre-cleaning costs with a Wyandotte Solvent Detergent.

For example: A company which formerly used a commercial alkali (sodium meta silicate) for pre-cleaning washing machine parts found the cost per machine was \$2.40 a day.

Then they switched to a Wyandotte Solvent Detergent.

They now pre-clean the parts at a saving of \$1.69 a day (\$423 per year, per machine), and report that a better finish results, and that the life of electro cleaner baths is longer because of efficient pre-cleaning.

Call your Wyandotte Service Representative now. He'll be glad to show you how you can save money with a Wyandotte Solvent Detergent. Write us for further information.

Wyandotte

SERVICE REPRESENTATIVES IN 88 CITIES

THE J-B-FORD SALES CO. WYANDOTTE MICH.

Dissolve a tablespoon of No. 1 in 2 quarts of warm water and bathe the afflicted parts, bathing for about 15 minutes, keeping the solution as warm as you can stand it. Then dry with a warm towel. Do not rub, but allow the towel to absorb the moisture. Rubbing will irritate and may spread the infection. Then immediately apply the following by rubbing lightly:

Formula No. 2

Lanolin	4 ozs.
Olive oil (sterilized)	1 oz.
Thymol iodine	1 dram
Starch	sufficient

This ointment will penetrate very readily and give almost instant relief. If treatment is used regularly once or twice daily, it will soon cure this ailment which is so prevalent among the help that are

employed in the plating departments.

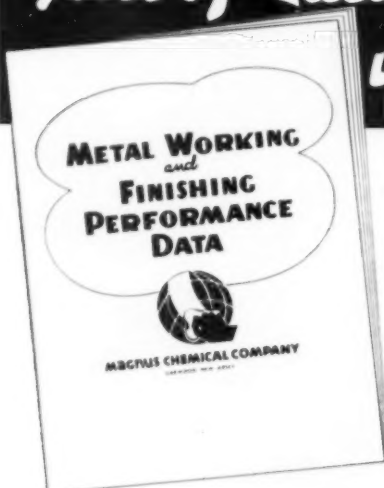
Yours very truly,
Arthur E. Hogan

Associations and Societies

American Electroplaters' Society Boston Branch

The committee for the annual meeting, to be held in Boston, June 9-12 was given in the July issue of METAL FINISHING. One correction should be made: the address of Banquet and Entertainment Committee Chairman, Louis Tosi, was given erroneously as 80 Osborn St., Cambridge, Mass., and should be 80 State St., Cambridge.

Full of Ideas and Methods you need now.



This Performance Data book is designed to help you select the cleaning methods and materials that will improve product quality, cut costs and insure smooth, dependable production—results so essential to the metal working industry in connection with the national defense program now under way.

GET YOUR COPY

The data book outlines what users of Magnus Metal Working and Cleaning Materials have been able to accomplish along these lines in comparison with formerly used materials and methods. Their reports are full of usable and practical ideas that will help you save money, speed production and meet rigid quality specifications.

A mighty fine addition to your reference file—you'll use it a lot. Write for your copy today.

MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

11 South Avenue

Garwood, N. J.

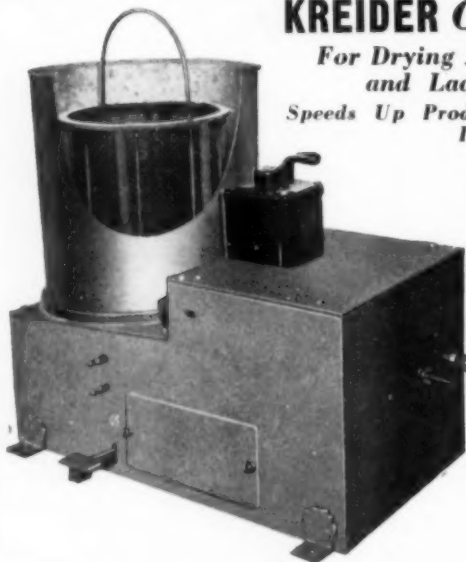


MAGNUS CLEANERS

KREIDER Centrifugal DRYER

For Drying All Types of Plated Work
and Lacquering Small Parts

Speeds Up Production . . . Cuts Costs . . .
Improves Quality



The new Kreider Centrifugal Dryer reflects our many years' experience in this field. It is the result of our engineers' effort to produce the best. Although unusually simple in design and easily operated by one man, the Kreider Dryer speeds up production and improves the quality of the work.

An auxiliary steam heating unit can be supplied as standard equipment when drying parts which have a tendency to retain water and additional steam is needed in the drying operation. Reversing drum switch is supplied on all dryers.

Write for Complete
Specifications and Prices

DELLINGER MANUFACTURING CO.

727 North Prince Street
Lancaster, Pa.

Branch Outings

Lancaster Branch—August 10th.

Newark Branch—September 7th. The annual picnic of the branch will be held at Vogel's Grove, Liberty Ave., Union, N. J. Payment, \$2.00 for adults; \$1.00 for children. From 10:00 A.M. until 7:00 P.M. The menu consists of: clams on the half-shells; hamburgers, hot dogs, sausages, tomatoes, radishes, scallions, corn on the cob, beer and soft drinks. All you want, anytime you want it, and as often as you want it.

21st Metal Congress

The 21st National Metal Congress, to be held in Cleveland, October 21 to 25, is showing every indication of being such an outstanding collection of papers as to mark an epoch in the technical sessions of the American Society for Metals.

The cooperating societies also have their programs well advanced, the American Welding Society having 55 papers to present at their sessions, while the Institute of Metals and Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers and the Wire Association have planned extensive programs.

The American Society for Metals will have approximately 14 sessions besides the educational lectures in the late afternoon and early evening.

The National Metal Exposition is "going to town". It is at present the largest show that has ever been held in the long history of the Society. Over 235 exhibitors have reserved 90,000 square feet of exhibit space, and three extensions of the "space available" have been rendered necessary by the demand for representation in this exposition.

It has been determined that the theme of this exposition will be "New Aids to Production". This is particularly appropriate at this time in the light of the tremendous activity in national defense and industrial expansion.

The exposition is to be held in the Cleveland Public Auditorium concurrently with the National Metal Congress the week of Oct. 21.

Hotel Statler will be the headquarters for the American Society for Metals, Hotel Cleveland for the American Welding Society and the American Institute of Mining and Metallurgical Engineers, and Hotel Carter will be the headquarters for the Wire Association.

Electrochemical Society

The Fall meeting of the Society will be held at Ottawa, Canada. Following is the Ottawa Convention Committee:

General Committee: F. E. Lathe

Finance: F. J. Hamby

Ladies: Mrs. F. E. Lathe

Registration & Equipment: A. A. Swinerton

Plant Visits and Transportation: R. J. Traill

Luncheons and Dinners: P. Larose

Dance: G. D. Mallory

Tentative program is as follows:

TENTATIVE PROGRAM FOR OTTAWA

Wednesday, October 2, 1940

- 8:00 p.m. Meeting of Board of Directors
Registration

Thursday, October 3, 1940

- 9:00 a.m. Registration
Technical Sessions
Morning left open for ladies
12:30 p.m. Luncheon for ladies and gentlemen
1:45 p.m. Motor to Seignior Club (45 miles)
3:15 p.m. Arrive at Seignior Club for golf, tennis, swimming, etc. (Golf \$1.50, Dinner \$1.50 plus Tax)
6:30 p.m. Dinner at Seignior Club
9:00 p.m. Leave for Ottawa

Friday, October 4, 1940

- 9:00 a.m. Technical Sessions
Registration
10:00 a.m. A drive around the city for the ladies and luncheon at a golf club or with the men at the Chateau Laurier.
12:30 p.m. Luncheon (possibly a short address)
2:15 p.m. Visits to National Research Laboratories and Bureau of Mines
Visit by Ladies to the National Museum of Canada and Art Gallery, or open
7:00 p.m. Annual dinner and dance

Saturday, October 5, 1940

- 9:00 a.m. Registration
Technical Sessions
12:30 p.m. Luncheon for ladies and gentlemen
2:00 p.m. Adjournment (afternoon trains leaving for Montreal and Toronto arrive at those points in time to connect with night trains for New York, Chicago and other centers).

Obituaries

Martin Kan

Martin Kan, New York representative of the Magnuson Products Corporation of Brooklyn, N. Y., died on June 12th, 1940.

Mr. Kan had been in poor health for the past two years, and had spent several months in the hospital during 1938 and 1939. Since last March he had not been able to work. He had been with the Magnuson Products Corporation fourteen years, and was highly esteemed by the president, Mr. Magnuson and the other officials of

BETTER DEPOSITS EASIER PLATING

By test and by experience, many skilful platers know that Harshaw anodes and salts produce superior deposits. . . . They depend on Harshaw Quality for maximum ductility, rust resistance, and attractiveness of their finishes. . . . Harshaw products help eliminate rejects and interruptions in production. . . . Harshaw exact quality anodes and salts simplify your plating operations and make plating easier.

THE HARSHAW CHEMICAL CO.

Offices and Laboratories: Cleveland, Ohio
Quality products since 1892

New York, Philadelphia, Chicago, Detroit, Pittsburgh, Cincinnati, East Liverpool, Los Angeles, San Francisco.

Works at Cleveland and Elyria, Ohio and Philadelphia, Pa.

NATROLIN

TRADE MARK

"B-4 CHROME" CLEANER

FOR

Cleaning Nickel "BEFORE" Chrome

SULPHUR PRODUCTS CO., Inc.

Greensburg, Pa.

CHROMIC ACID

99.75% PURE

Stocks of Mutual Chromic Acid are available in all principal industrial centers, where Mutual distributors stand ready to give complete technical service supplemented and supported by the research and development facilities of the world's largest manufacturer of chromium chemicals.

BICHRIMATE OF SODA
BICHRIMATE OF POTASH



MUTUAL CHEMICAL CO. OF AMERICA

270 MADISON AVE.

NEW YORK

PLANTS AT BALTIMORE AND JERSEY CITY

MINES IN NEW CALEDONIA

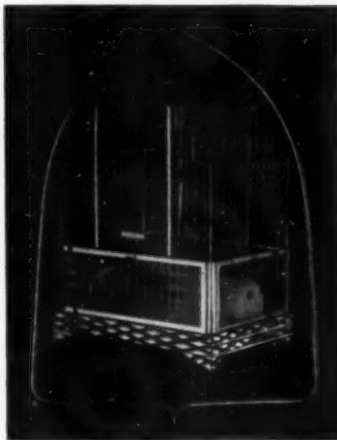
CASTLES FOR CANARIES

The Taj Mahal for a bird cage, table lamps of silver satin, pens of shimmering gold. American Bonded Metals lend a touch of beauty and vivid imagination to the dull . . . the commonplace . . . to your own product be it an automobile or a cocktail shaker. And do it at a savings to you. Coming to you completely *pre-finished*, they can be drawn, stamped, formed or assembled into your completed product. Elimination of plating—either before or after fabrication—polishing or buffing provide production savings that mean added profits. Write on your company letterhead for a new brochure covering the latest in *pre-finished* metals, designs, patterns and ideas.

Sales Offices in All Principal Cities

AMERICAN NICKELOID COMPANY

8 SECOND ST.—PERU, ILL.



the corporation, as a faithful and loyal employee.

Due to the high regard for Mr. Kan's efficiency as a selling representative and his fidelity to his work, the Magnuson Products Corporation have generously arranged for Mrs. Kan to receive a share of the income from the sales to those customers which Mr. Kan had served so conscientiously in past years.

Hutton H. Haley

Hutton H. Haley, 53, Detroit District Sales Representative of the American Foundry Equipment Co., Mishawaka, Ind., died March 1.

Mr. Haley started his business life as a broker of foundry supplies in Kansas City. In 1911 he joined the Sand Mixing Machine Co., which later became The American Foundry Equipment Co. This was the beginning of a continuous association with that company.

He was appointed Sales Manager in 1926, but resigned a year later to take charge of sales in the Detroit territory, a position he held until his death.

Mr. Haley was especially well known in foundry circles. In the early days when the Sandcutter was first marketed, Mr. Haley covered practically the entire territory east of the Mississippi. He was remarkably successful in introducing these machines to the foundries of America.

Later, when American originated the "Wheelabrator" airless method of abrasive blasting, Mr. Haley was again responsible for a very important percentage of the machines placed in operation.

The American Foundry Equipment Co., as well as the foundry industry, has lost an active contributor to foundry progress and development. Mr. Haley was a prominent member of the A. S. M. and for many years was very active in affairs of the A. F. A.

Personals

Frederick Gumm Chemical Co., Inc. Announce Additions to Their Staff

Fred Gumm, president of Frederick Gumm Chemical Co., Inc., 538 Forest St., Kearny, N. J., has announced the addition of *George Muscio* and *Ernest Hinterleitner* to the company's staff.

Messrs. Muscio and Hinterleitner will do research and development work in the company's laboratory.

Mr. Hinterleitner was formerly connected with United Chromium, Inc., and Mr. Muscio for the past five years was chief chemist of the Lea Mfg. Co., Waterbury, Conn. He is a graduate of Yale University, a veteran of the World War, seeing service in France and being gassed in action. During his career he has been employed with many prominent companies.

such as the Tiffany Company, Hanson-Van Winkle-Munning Co., and the Lea Mfg. Company.

Colonel A. L. Mercer, president and H. L. Trembicki, manager of the Metal Cleaner Department of the Cowles Detergent Company, Cleveland, Ohio announce the appointment of another sales representative, John W. Dobson. Mr. Dobson will cover Metropolitan New York and the state of New Jersey south to Trenton.

Mr. Dobson is very well qualified for his new position with Cowles as his background covers work in the alkali and metal fields. Close cooperation will be maintained with Cowles metal cleaner distributors in this territory, the James H. Rhodes Company of Long Island City and the National Oil & Supply Company of Newark.

Paul A. Oldam Heads Plating and Finishing Depts. of Shiman Mfg. Company

Paul A. Oldam, has become head of the polishing, plating and finishing departments of the Shiman Manufacturing Co., Newark, N. J., manufacturers of fine gold, scholastic and emblematic jewelry.

Mr. Oldam was formerly head of the plating department of E. Poeter & Co., Irvington, N. J. He has had twenty-one years of practical and technical experience at polishing and plating, devoted almost entirely to precious metal electroplating as applied to jewelry and metal novelty finishes. Mr. Oldam was also employed by J. K. Osborn Mfg. Co., Har-



Paul A. Oldam

rison, N. J., Jos. Ross & Co., Irvington, N. J., August Goertz & Co., Newark, as general plating department foreman and assistant to the late Oliver J. Sizelove; Shiman Mfg. Co., and Blacher Bros., Providence, R. I.

His knowledge of chemistry and electrochemistry was obtained at high schools, vocational schools, the Newark Technical School, and Pratt Institute of Technology, Brooklyn, N. Y.

"RACKS STILL IN SERVICE

AFTER 8 MONTHS"

Says This User of

**UNICHROME*
RACK COATING-W**

Still they come—the enthusiastic reports from manufacturers and job platers alike, after using "Unichrome" Rack-Coating*. For example, one user writes:—

"The rack we had coated eight months ago is still in service in our Chromium Plating cycle. Your Rack Coating W has been completely satisfactory".

The reason these "Unichrome" Rack Coating W users find this rack coating material so outstanding is its unequalled combination of advantages:—

1. Withstands boiling cleaners and all plating solutions
2. Tough—withstands wear and tear of handling
3. Contains no ingredients harmful to plating solutions
4. Cuts costs—reduces frequency of re-coatings
5. Easy to apply—"dip and force dry" method

6. Light in color—easy to see how well the rack is covered

7. Any part of rack can be recoated without recoating entire rack

Write for Bulletin 27 Containing Complete Information—

Platers without rack coating facilities may have their racks coated with "Unichrome" Rack-Coating W* by Chromium Corporation of America, 4645 West Chicago Avenue, Chicago, Illinois, Belke Manufacturing Company 947 North Cicero Avenue, Chicago, Illinois, or Lea Manufacturing Company of Waterbury, Connecticut.

UNITED CHROMIUM INCORPORATED

51 East 42nd Street, New York, N.Y.
2751 E. Jefferson Ave., Detroit, Mich.
Waterbury, Conn.

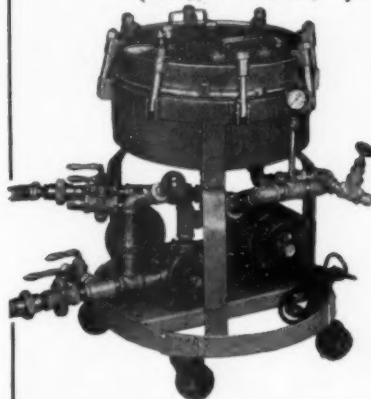
*Trade Mark
Reg. U.S. Pat. Off.



NEW SPARKLER

HORIZONTAL PLATE ACTIVATED CARBON AND FILTER AID FILTER

ENGINEERED FOR THE MODERN PLATING SOLUTIONS
(Bright Nickel, Cyanide Copper, Chromium, etc.)



Horizontal plates permit building up more uniform and thicker cake of carbon and filter aid assuring a sharper and more uniform result under all conditions. Horizontal cake is not disturbed by intermittent operation. Very economical to operate and simple to clean. No cloths or screens to wash. No waste of liquid being filtered.

Available in stainless steel, iron or rubber.

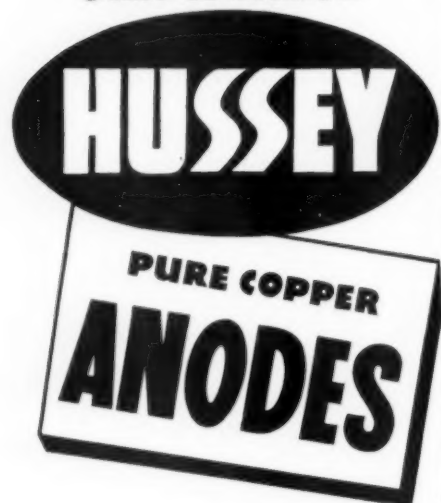
Write for free literature.

SPARKLER MFG. CO.

1214 Webster Ave.

Chicago, Ill.

**Any SIZE
OR SHAPE
Cast or Rolled**



Fast, uniform deposits, less tank-time, fewer kilowatt hours, freedom from discoloration and blemishes . . . these advantages speed your operations using Hussey Copper Anodes. Available in any size or shape, cast or rolled pure lake copper. Order your supply from the nearby Hussey Warehouse.

C. G. HUSSEY & CO.

(Division of Copper Range Co.)

Rolling Mills & General Offices: Pittsburgh, Pa.

Warehouses in Principal Cities

Magnuson Products Corp., Brooklyn, N. Y., have announced that *Lionel de Waltoff* will succeed the late *Martin Kan* as representative of the company in the New York district.

Walter C. Davis will represent the *Tolhurst Centrifugal Division and DeBothezat Ventilating Equipment Division of American Machine and Metals, Inc.*, in Maryland, Virginia, and the District of Columbia, the company has announced. Mr. Davis, a graduate of the University of Tennessee School of Chemical Engineering, was formerly associated with Du Pont and the General Chemical Company. He will make his headquarters in Baltimore.

Business Items

Chas. F. L'Hommedieu & Sons Co., 4521 Ogden Ave., Chicago, Ill., have announced the appointment of *Oliver M. Shoe*, 260 N. 11th St., Philadelphia, Pa., as their sales representative in that

vicinity. Mr. Shoe is especially conversant with modern engineering problems in plating and finishing. His father, *W. W. Shoe*, owned and operated the *Star Nickel Plating Works*, established in 1870 in Philadelphia. Mr. Shoe succeeded his father in this business and has devoted the greater part of his time to this industry. The best wishes of his many friends in industry are extended to him.

Cowles Detergent Co., Cleveland, Ohio, because of their need for more space, caused by expansion, have moved to larger offices. On and after August 31, the executive and general offices of this company will be located at 7016 Euclid Avenue, Cleveland. There will be no interruption in business affairs during the change in location. All friends and customers of the company are cordially invited to inspect the new quarters after September first.

Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N. Y., military and other airplanes and parts, has leased about 120,000 sq. ft. additional space in above

Magnuson Says:

**"I'll cut your
Cleaning Costs"**

I can show you where PERMAG Cleaning Compounds reduced cleaning costs 65 per cent, for a manufacturer of metal goods. Rejects were held down to almost nothing, and this manufacturer was able to meet the keenest kind of competition in his next selling campaign.

We have a RESEARCH SERVICE that works out Cleaning Problems, and shows how to handle cleaning jobs more efficiently and at less cost. Write me. No obligation for an interview.



PERMAG CLEANING COMPOUNDS

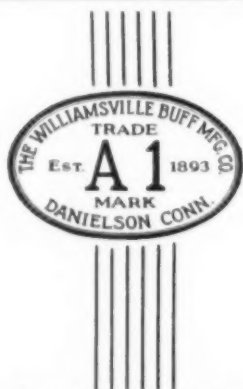
MAGNUSON PRODUCTS



CORPORATION

HOYT & THIRD STS. BROOKLYN, N.Y.

Representatives from Coast to Coast. Warehouses in Principal Cities.
In Canada: Canadian Permagon Products Ltd., Montreal and Toronto.



"A1"

MAGIC letters are these in Dun and Bradstreet, and they're equally assuring on a buff wheel. Since 1893 our buffs have been known by the A1 trademark, assurance of quality and workmanship.

BUY WILLIAMSVILLE BUFFS

building, for expansion in parts production and assembling divisions, bringing the plant occupancy to 440,000 sq. ft. Cost close to \$600,000; majority of fund to be expended for equipment. The following departments are operated: rolling, drawing, extruding, stamping, sand-blasting, grinding, polishing, buffing, lacquering, enameling and painting. Steel and bronze are the principal base metals used.

Col. A. L. Mercer, president and H. L. Trembicki, manager of the Metal Cleaning Department of the Cowles Detergent Co., Cleveland, Ohio, announce the appointment of the James H. Rhodes & Co., as distributors of Cowles anhydrous metal cleaners. The James H. Rhodes & Co., will maintain complete stocks of Cowles cleaners in their warehouses at 48-02-29th St., L. I. City, N. Y., and 153 Hubbard St., Chicago, Ill. The Cowles Detergent Co. will work closely with the Rhodes organization and will render any service necessary.

The Anderson Co., Gary, Ind., has petitioned the U. S. District Court proposing an arrangement with its unsecured creditors under the provisions of the Act of Congress relating to bankruptcy and that a meeting of its creditors will be held in the Court Room in the Federal Bldg., South Bend, Ind., on August 30 at 10:00 o'clock in the forenoon.

Foote Mineral Co., 4041 Ridge Ave., Philadelphia, Pa., has announced that William A. Maxwell, has joined the research staff of the company. Mr. Maxwell, who recently received his degree in chemical engineering from the South Dakota School of Mines, specialized in the chemistry of the less familiar group of elements as well as mineralogy. He will devote most of his time to process development.

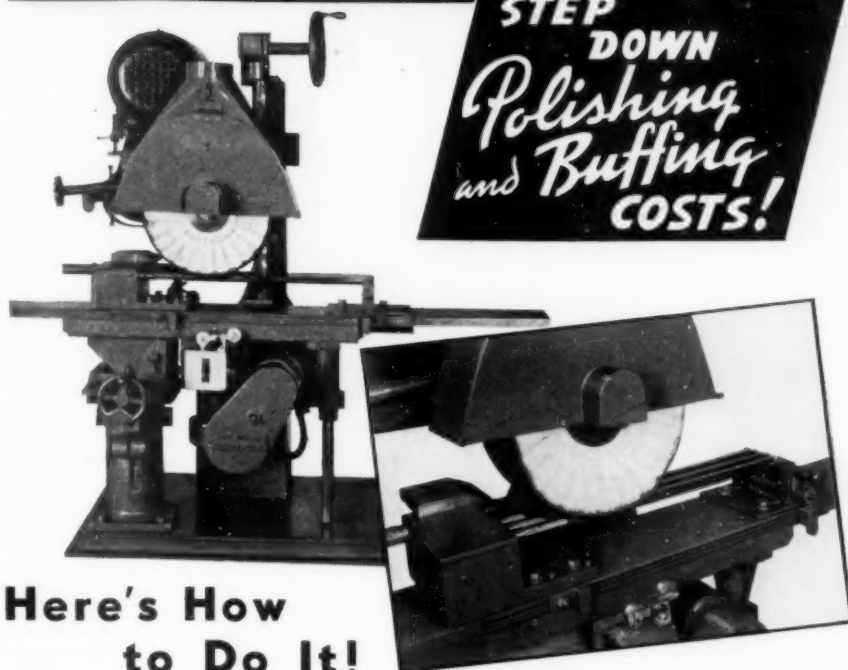
Garden City Plating & Mfg. Company, 1430 S. Talman Ave., Chicago, Ill., plated metal wares, plan a two-story and basement addition. Cost close to \$45,000 with equipment.

J. L. Fosnight has acquired complete control of the USL Electric Welder Division Electric Auto-Lite Co., Toledo, Ohio, and incorporated a new company in the state of Ohio, which will be known as the US Electric Welder Corp., 1224 W. Bancroft St., Toledo, Ohio. The USL welder will be sold under the trade name of US Welder, and J. L. Fosnight will act as president and general manager of the new company. Mr. Fosnight has been associated with the Electric Auto-Lite Co. for more than 24 years as sales manager of the USL Welder Division.

Ohio Blow Pump Co., have moved their offices from 13005 Taft Ave., Cleveland, Ohio, to 1727 Doan Ave., E. Cleveland.

B. F. Goodrich Co., Akron, Ohio, automobile tires and tubes, has let general contract for several one-story additions to branch mill at Oaks, near Philadelphia, for increase in production, storage and distributing divisions. Cost close to \$300,000 with equipment.

Step Up Production!



STEP DOWN
Polishing and Buffing
COSTS!

Here's How to Do It!

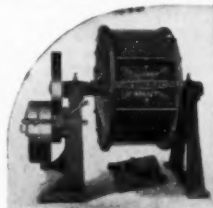
Take advantage of the speed and economy made possible by an Acme Automatic, increasing your production and, at the same time, decreasing your unit cost. Let us show you how an Acme Automatic can be adapted to meet your individual problem of polishing and buffing. If your production is lagging, our engineering staff will be glad to study your requirements and make a recommendation without charge or obligation.

**SEND
SAMPLE
for
FREE
Production
Estimate**

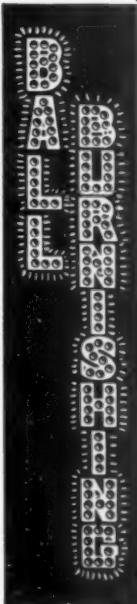
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1642 HOWARD ST. • DETROIT, MICH.
Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

for Better plated surfaces

Prepare for a fine plate first by burnishing small, metal parts. After plating, burnish again. That rolls down the surface, closes pores, increases resistance to corrosion. Pressure does the job. Therein lies the advantage of Abbott high, narrow barrels which take a charge of several hundred pounds of steel burnishing materials. This mobile weight, confined within an upright area, develops maximum pressure on the work. Questions gladly answered. Orders promptly filled.



The Abbott Ball Company
"Burnishing and Cutting-down Barrels—Burnishing Balls and Materials."
1046 New Britain Ave. Hartford, Conn.



Supply Prices, July 29, 1940

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.			
COPPER: Cast	21½c. per lb.	NICKEL: 90-92%, 16" and over	.45 per lb.
Electrolytic, full size, 16½c.; cut to size	16½c. per lb.	95-97%, 16" " "	.46 per lb.
Rolled oval, straight, 17½c.; curved	18½c. per lb.	99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48c.	
BRASS: Cast	18½c. per lb.	SILVER: Rolled silver anodes .999 fine were quoted from 38c. per Troy ounce upward, depending on quantity.	
ZINC: Cast	11½c. per lb.		

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, Pure, l.c.l., drums	lb.	.07	Gum, Arabic, white, powder, bbls.	lb.	.125-14
Acid, Boric (boracic) granular, 99.5%, bbls.	lb.	.053-.059	Sandarac, prime, bags	lb.	.50
Chromic, 99%, 100 lb. and 400 lb. drums	lb.	.16½-.17½	Hydrogen Peroxide, 100 volume, carboys	lb.	.20
Hydrochloric (muriatic) Tech., 20°, carboys	lb.	.027	Iron Sulphate (Copperas), bbls.	lb.	.017
Hydrochloric, C.P., 20°, carboys	lb.	.08	Lead, Acetate (Sugar of Lead), bbls.	lb.	.11-13½
Hydrofluoric, 30%, bbls.	lb.	.07-.08	Oxide (Litharge), bbls.	lb.	.125
Nitric, 36°, carboys	lb.	.06	Magnesium Sulphate (Epsom Salts), tech., bag	lb.	.018
Nitric, 42°, carboys	lb.	.075	Mercury Bichloride (Corrosive Sublimate)	lb.	\$1.58
Oleic (Red Oil), distilled, drums	lb.	.07½-.08½	Mercuric Oxide, red, powder, drums	lb.	\$3.36
Oxalic, bbls. l.c.l.	lb.	.12-14	Nickel, Carbonate, dry, bbls.	lb.	.36-41
Stearic, double pressed, distilled, bags	lb.	.09½-.11½	Chloride, bbls.	lb.	.18-22
single pressed, distilled, bags	lb.	.09½-.10½	Salts, single, 425 lb. bbls.	lb.	.135-145
triple pressed, distilled, bags	lb.	.12½-.13½	Salts, double, 425 lb. bbls.	lb.	.135-145
Sulphuric, 66°, carboys	lb.	.025	Paraffin	lb.	.05-.06
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.175	Perchloroethylene, drums	lb.	.08½
Butyl-normal, l.c.l., drums	lb.	.095-105	Phosphorus, red, cases	lb.	.42
Denat., S.D. #1, 190 pf., 1-18 drms, wks. gal.	gal.	.335	yellow, cases	lb.	.40
Diacetone, pure, drums, l.c.l.	lb.	.10	Potash, Caustic, 88-92%, flake, drums, works	lb.	.07½-.075
Methyl, (Methanol), 95%, drums, l.c.l. gal.	gal.	.36-435	Potassium, Bichromate, crystals, casks	lb.	.09½
Propyl-Iso, 99%, l.c.l., drums	gal.	.41	Carbonate (potash) 98-100%, drums	lb.	.06½
Propyl-Normal, drums	gal.	.70	Cyanide, 94-96%, cases	lb.	scarce
Alum, ammonia, granular, bbls., works	lb.	.035	Pumice, ground, bbls.	lb.	.03
Potash, granular, bbls., works	lb.	.0375	Quartz, powdered	ton	\$30.00
Ammonia, aqua, 26°, drums, carboys	lb.	.02½-.05½	Quicksilver (Mercury) 76 lb. flasks	flask	\$196.
Ammonium, chloride (sal-ammoniac), white, granular, bbls.	lb.	.0521-.075	Rochelle Salts, crystals, bbls.	lb.	.26½
Sulphate, tech., bbls.	lb.	.035-.05	Rosin, gum, bbls.	lb.	5.25-7.75
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	scarce	*Silver, Chloride, dry, 100 oz. lots	oz.	.32
Sulphocyanide (thiocyanate), com'l, drums	lb.	"	Cyanide, 100 oz. lots	oz.	.33½
Antimony Chloride (butter of antimony), sol., carboys	lb.	.13	Nitrate, 100 oz. lots	oz.	.27
Barium Carbonate, ppted., l.c.l., bags, works	lb.	.03	Sodium, Carbonate (soda ash), 58%, bbls.	lb.	.0235
Benzene (Benzol), pure, drums, works	gal.	.20	Cyanide 96%, 100 lb. drums	lb.	.15
Butyl Lactate, drums	lb.	.235	Hydroxide (caustic soda) 76%, flake	lb.	.0355
Cadmium Oxide, l.c.l., bbls	lb.	.85	Hypsulphite, crystals, bbls.	lb.	.035-.065
Calcium Carbonate (Ppted. chalk), U.S.P.	lb.	.05½-.075	Metasilicate, granular, bbls.	lb.	.0335
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.05½-.06	Nitrate, tech., bbls.	lb.	.029
Carbon Tetrachloride, l.c.l., drums	gal.	.73	Phosphate, tribasic, tech., bbls.	lb.	.0295
Chrome, green, commercial, bbls.	lb.	.21	Pyrophosphate, anhydrous, bbls., l.c.l.	lb.	.0580
Chromic Sulphate, drums	lb.	.26½	Sesquisilicate, drums	lb.	.0425
Cobalt Sulphate, drums	lb.	.65	*Stannate, drums	lb.	.35-.38
*Copper, Acetate (verdigris), bbls.	lb.	.25	Sulphate (Glauber's Salts), crystals, bbls., works	lb.	.0135
Carbonate, 53/55%, bbls.	lb.	.16½-.17½	Sulphocyanide, drums	lb.	.30-.35
Cyanide, Tech., 100 lb. bbls.	lb.	.34	Sulphur, Flowers, bbls., works	lb.	.037-.0410
Sulphate, Tech., crystals, bbls.	lb.	.051	*Tin Chloride, 100 lb. kegs	lb.	.39½
Cream of Tartar (potassium bitartrate), gran., bbls.	lb.	.34½	Toluene (Toluol), pure, drums, works	gal.	.32
Crocus Martis (iron oxide) red, tech., kegs	lb.	.07	Trichlorethylene, drums	lb.	.08½
Dibutyl Phthalate, l.c.l., drums	lb.	.195	Tripoli, powdered	lb.	.03
Diethylene Glycol, l.c.l., drums, works	lb.	.155	Wax, Bees, white, bleached, slabs 500 lbs.	lb.	.36-40
Dextrine, yellow, kegs	lb.	.05-.08	Bees, yellow, crude	lb.	.24-28½
Emery Flour (Turkish)	lb.	.07	Carnauba, refined, bags	lb.	.50-.60
Ethyl Acetate, 85%, l.c.l., drums	lb.	.075-.085	Montan, bags	lb.	.27½-.30
Ethylene Glycol, l.c.l., drums, works	lb.	.17-20	Spermaceti, blocks	lb.	.24-27
Flint, powdered	ton	30.00	Whiting, Bolted	lb.	.025-.06
Fluorspar No. 1 ground, 97-98%	ton	\$60.00	Xylene (Xylol), drums, works	gal.	.31
Fusel Oil, refined, drums	lb.	.125-14	Zinc, carbonate, bbls.	lb.	.13½-.16
*Gold, Chloride	oz.	\$18½-23	Cyanide, 100 lb. kegs	lb.	.33
Cyanide, potassium 41%	oz.	\$15.45	Chloride, granular, drums	lb.	.06
Cyanide, sodium 46%	oz.	\$17.10	Sulphate, crystals, bbls.	lb.	.04

*Subject to fluctuations in metal prices.

AUGUST, 1940

ORGANIC FINISHING

SECTION OF METAL FINISHING



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AUGUST, 1940

CONTENTS

ARTICLES

- Precautions in the Use of
Organic Finishing Mater-
ials — By Raymond F.
Peabody 462
- Hints on Handling Finish-
ing Materials—By E. M.
Stephenson 464
- New Degreaser Installa-
tions in Southern Califor-
nia—By Fred Herr 465
- Air Filters for Organic
Finishing 467

DEPARTMENTS

- Organic Finishing Digest. 469
- Solvents in Industry 470
- New Equipment and
Supplies 471
- Manufacturers' Literature . 471
- Questions on Organic
Finishing 473

Explosive Limits of Solvents

Solvents, when vaporized in air, may form explosive mixtures within certain fixed limits of solvent vapor concentration. The reaction proceeds with a great evolution of heat and at enormous speed, forming what is known as an explosive wave. The mixture may be ignited by a spark, hot solids or open flame.

The limits for the explosive range of individual solvents are sharp, but, however, a third component added to the solvent vapor-air mixture, will alter the explosive ranges. Many solvents do not form explosive mixtures with air at room temperature; because of low vapor pressure the maximum vapor concentration is less than the lower limit of explosivity. Of course, increase in the vapor pressure by heating can cause sufficient vaporization of such solvents to allow explosive concentrations to form.

If solvents form azeotropic mixtures, mixed solvents even with high flash points, may form vapor-air mixtures which are explosive at room temperature, and this possibility should not be overlooked when solvents are used.

Benzene and toluene have particularly low vapor-air explosive ratios probably due to their high calorific content. A volume per cent of 1.3 (0.0487 g./l.) of toluene in air, is the lower limit of explosivity, which is about the order of ether, whereas ethyl acetate, ethyl alcohol and methyl alcohol are several times greater. Care should be taken that the concentration of solvent vapors in the atmosphere of the work room should be below the explosive limits, by suitable exhausting or ventilation. Poor exhausting is both physiologically harmful and a fire hazard.

Precautions in the Use of Organic Finishing Materials

By Raymond F. Peabody

It is well agreed that the use of lacquers, enamels, japons and other organic finishing materials can be hazardous to both property and life under certain conditions. The principal reason for this is the possible danger from the volatile organic solvents commonly associated with organic finishing materials, both in the form of thinners and as constituents of the materials themselves as manufactured. These hazards arise from certain properties of the solvents which are characteristic of them as a class to a greater or lesser extent, namely, their flammability and explosivity and their physiological effects.

The dangers from solvents will, of course, vary with their type, chemical composition, the conditions under which they are used and other factors. However, it may be safely stated that wherever solvents are used there is the possibility of danger and that protective measures must be followed. This

A valuable paper discussing fire hazards encountered in the use of organic finishing materials. Flammability and explosivity are discussed in detail, and data are given on the physical properties of various solvents used in organic finishing materials. These data include flash points, explosive limits, auto-ignition temperatures and suitable extinguishing agents. Detailed precautions and protective measures are also outlined.—Ed.

applies particularly where large quantities of solvents are involved, as in production spraying, dipping and other finishing operations.

Flammability and Explosivity

With few exceptions, the solvents used with organic finishing materials are flammable substances and therefore are distinct fire risks. They may be set afire by an open flame or a spark, by contact with an incandescent body such as a glowing metal, or, if they are raised to a sufficiently high temperature, by spontaneous ignition.

Of particular value in indicating the flammability of solvents are their flash points and burning points. The flash point of a solvent may be defined as that temperature at which the solvent, held in a vessel of specified dimensions, liberates vapor at such a rate that the mixture of solvent vapor and air immediately above the surface of the solvent is ignitable. The burning point is that temperature at which the evaporation proceeds at such a rate that the vapors not only ignite but continue to burn.

There are a number of types of apparatus employed in the determination of flash points, including the Abel, the Pensky-Mortens and others. The operation of each type is somewhat similar. The solvent to be tested is heated at a definite rate in a small container.

At certain intervals in the rise in temperature, a small flame is applied to the space above the solvent. The flash point is taken as the minimum temperature at which the solvent vapor/air mixture gives a momentary flash. Figure I. shows one of the types of flash point apparatus.

With regard to explosivity, the vapors of some solvents are capable of forming mixtures with air which burn with extreme rapidity and violence. In these mixtures the solvent vapors must be present in the air within certain fixed limits of concentration (explosive limits) and must be exposed, as in the case of flammability, to an open flame, a spark or etc. Explosive limits of volatile solvents are usually determined in an air filled explosion apparatus (Figure II) designed for the purpose, into which carefully weighed amounts of the solvents are evaporated. A spark from an ignition coil is used to set off the explosion, if any.

Table I. lists the flash points, explosive limits, etc. of some of the more common volatile organic solvents



Fig. I. Flash point tester (Closed Cup).
(Courtesy Fisher Scientific Co.,
Pittsburgh, Pa.)

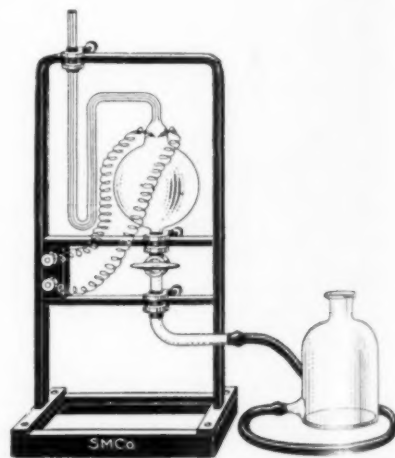


Fig. II. Hempel explosion pipette.

found in organic finishing materials and thinners.

Physiological Effects

Although the flammability and explosivity of some solvents may present small hazard, practically all of these materials have some physiological effects, either in the liquid form or, more particularly, as vapor in the air. The effects are of three general types: first, irritation of the skin and the mucous membranes of the eyes, nose, etc.; second, narcotic effects; and last, injury to internal organs such as the liver, kidneys, etc. The extent of such physiological effects depends on the solvent, concentration of the vapor in the air, length of exposure, susceptibility of the individual, etc.

Precautions and Protective Measures

In view of the various risks attending the use of organic finishing materials containing volatile solvents, it becomes necessary to apply a complete plan of precautions and protective



Fig. III. A safety blanket for extinguishing clothing fires.

(Courtesy Mines Safety Appliances Co., Pittsburgh, Pa.)

measures. The following general considerations constitute such a plan: (1) the maintenance of solvent vapors in the air at a safe minimum; (2) the elimination of all possibilities of sparks, flames, etc. which might produce fire or explosion; (3) the use of properly designed equipment and the correct operation of that equipment; (4) the consistent use of safety devices; (5) cleanliness and good house-keeping.

Some specific safety measures are listed below:

The finishing department should be located in a separate building of proper design, in a one story properly cutoff addition or within a properly cutoff section of a fire-resistant building.

All electrical equipment including motors, switches, lights, etc. should be of approved design and so located as to offer no possibility of danger.

The finishing department should be clean and orderly at all times. Spray booths, drip pans, etc. should be cleaned periodically and the residue disposed of immediately on collection. Rags, paper and similar combustible materials should not be allowed to accumulate.

The finishing department, including the room in which materials are prepared for use, should be equipped with properly designed air exhausting equipment.

The main supply of finishing materials and thinners should be kept separate from the finishing department proper.

Finishing materials should be prepared only in such quantities as are necessary for immediate use.

All containers of finishing materials and thinners from which such materials are dispensed through valves, by pouring, etc. should be suitably grounded.

Containers of finishing materials should not be warmed by placing within baking or drying ovens or on steam or hot water pipes.

All rooms in which finishing materials and thinners are handled should be equipped with proper fire extinguishing apparatus.

Smoking of pipes, cigarettes, etc., the carrying of matches and lighters, the use of open flames, welding torches, etc. should be forbidden wherever finishing materials are stored, prepared or applied.

Air compressors should not derive their air supply from rooms in which



Fig. IV. A safety type non-sparking booth scraper.

(Courtesy Binks Mfg. Co., Chicago, Ill.)

finishing materials and thinners are handled.

Wherever possible, dip tanks should be provided with covers of non-combustible material so arranged as to close automatically in the event of fire.

Dip tanks should be provided with overflow pipes and, where necessary, with automatic drains.

All tools used in cleaning spray booths, drip pans, etc. should be of non-sparking types of materials. Steel tools should be prohibited.

Any alterations or repairs on spray booths, dip tanks, material containers, etc. should be started only after such equipment has been thoroughly cleaned.

Baking or drying ovens should be cleaned periodically of the accumulation of drippings dirt, etc.

All baking or drying ovens should be suitably grounded.

Power transmission should be by direct or chain drive, not by pulleys and belting.

Suitable masks should be provided for use where solvent vapor concentrations are sufficiently high to be hazardous.

Protective hand cream should be provided for those who come in contact with finishing materials and thinners.

Only those workmen who are entirely dependable and thoroughly familiar with the handling of finishing materials, the operation of finishing equipment and the operation of safety devices should be employed.

PROPERTIES OF FLAMMABLE SOLVENTS (1)

Name	Synonym	Boiling Point °F.	Flash Point °F. Closed- cup	Open- cup	Explosive Limits, % by Vol. in air		Auto- ignition Temp. °F.	Suitable Extinguishing Agents
Acetone	Dimethyl ketone	134	0	15	2.15	13.0	1118	1,3,4
Amyl acetate, n-		300	76	80	1.1	—	714	3,4
Amyl acetate, iso-		290	92	100	—	—	715	3,4
Amyl alcohol, n-	Fusel oil	280	91	120	1.2	—	621	3,4
Amyl alcohol, prim-iso-	Butyl carbinol	270	109	115	—	—	667	3,4
Benzene	Benzol	176	12	—	1.4	8	1067	2,3,4
Butyl acetate, n-		260	72	90	1.7	15	790	3,4
Butyl acetate, iso-		244	64	—	—	—	—	3,4
Butyl alcohol, n-		243	84	110	1.7	—	693	3,4
Butyl alcohol, iso-		225	82	—	1.68	—	825	3,4
Butyl Cellosolve		340	141	165	—	—	472	1,3,4
Cellosolve	Ethyl Cellosolve	275	104	120	2.6	15.7	460	3,4
Cellosolve acetate		313	124	135	1.71	—	715	3,4
Denatured alcohol, 95%		175	60	—	—	—	—	3,4
Diacetone alcohol (comm'l)		329	48	55	—	—	—	3,4
Ethyl acetate	Acetic ether	171	24	30	2.18	11.5	907	3,4
Ethyl acetoacetate	Acetoacetic ester	356	184	—	—	—	799	1,3,4
Ethyl alcohol	Ethanol	173	55	—	3.28	19	—	1,3,4
Kerosene	No. 1 fuel oil	—	100-165	—	—	—	490	2,3,4
Methyl acetate		140	15	20	4.1	13.9	935	3,4
Methyl alcohol	Methanol	147	54	60	6.0	36.5	878	3,4
Methyl Cellosolve		379	107	115	—	—	551	3,4
Methyl ethyl ketone		176	30	—	1.81	11.5	—	3,4
Naphtha, coal tar	Hi-Flash naphtha	300-400	100-110	—	—	—	900-950	2,3,4
Naphtha, V.M. and P.	Benzine	212-320	20-45	—	1.2	6.0	450-500	2,3,4
Propyl acetate, n-		215	58	—	2.0	—	—	2,3,4
Propyl acetate, iso-		194	43	45	2.0	—	860	2,3,4
Propyl alcohol, n-		207	59	85	2.5	—	812	3,4
Propyl alcohol, iso-		181	53	66	2.5	—	852	3,4
Toluene	Toluol	232	40	45	1.27	7.0	1026	2,3,4
o-Xylene	o-Xylol	291	63	75	1.0	—	924	2,3,4

Suitable Extinguishing Agents Code

- | | |
|-------------------|------------------|
| 1. Water | 4. Dry chemical |
| 2. Foam | 5. Powdered talc |
| 3. Carbon dioxide | |

(1) From PROPERTIES OF FLAMMABLE LIQUIDS, GASES AND SOLIDS, prepared by the Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Hints on Handling Finishing Materials

By E. M. Stephenson

Hartford, Conn.

For some time I have been trying to persuade the furniture manufacturers to put a label on their furniture, naming the type of finish used, such as varnish, lacquer, shellac or synthetic enamel. This would be a great help to the retail furniture dealers or other persons who are finishing furniture as they now frequently get into trouble because they do not know what type of finish was used on the furniture.

One of the best strainers for heavy organic materials is made as follows:

Place a piece of cheesecloth between two pieces of wire mesh. In this way, a good support for the straining cloth is obtained and the upper wire mesh helps to break up the pigment, as you brush back and forth. It is also a good idea to moisten the cloth before placing it between the wire.

For cleaning spray cups of spray guns and other hollow containers, a good expedient is to use a hollow metal tube to lower the container into the cleaning thinner. The spray cup will remain upside-down as the hollow tube allows the air to escape and the thinner will fill the cup completely. The cup is placed on a rod fastened to the bottom of the tank. In this vertical position, the thinner will dissolve all the finishing material from inside and outside of the cup and as it dissolves, the material will fall to the bottom. For small parts, a mesh metal basket to hold these parts is recommended.

These hints will save irritation to the operator's hands, and of thinner.

In traveling around, the writer has noticed many people engaged in the handling of finishing materials who do not know how to pour liquids properly from a can. They think that the proper way is to punch a hole in the top of the can to allow the air to enter. This results in loss of material either through the punched hole or from the pouring spout. There is no need to spoil a good can as the proper way of pouring consists in turning the can so that the pouring spout is uppermost. In this manner, as little as a thimble full can be poured without spilling a drop, as there is no heavy pressure of the liquid to prevent entry of the air as is experienced when the pouring spout is held on the side or bottom of the can.

New Degreaser Installations in Southern California

By Fred Herr

Three degreasing installations, each with some new feature adapting the machine to the particular work to be cleaned, were recently acquired by Southern California plants.

The Weiser Manufacturing Co., 8635 Otis St., Southgate, Calif., manufacturers of builders' hardware, installed a degreasing machine to clean their regular production as well as a new line of hardware recently developed. A \$15,000 expansion and construction program now underway for enlarging and equipping the plating, lock and machine-shop departments was made necessary by the rapid increase in sales volume of a new line of locks.

The firm's new degreaser is a two-dip, gas-heated unit, capable of handling production up to 1,000 pounds

per hour. Light oils are removed from parts to be finished by holding them in the solvent vapors for a few seconds. Loads of closely nested parts containing heavier oils or drawing compounds are cleaned by immersion in the boiling solvent. This immersion is followed by a dip in a clean rinse chamber, and drying in hot vapors. In this installation, it was pointed out by Mr. Bruno Schindler, plating superintendent of the Weiser Co., that greater agitation than that secured in the boiling liquid was needed to remove caked tripoli from brass parts prior to plating and also from cast brass parts having polished surfaces and adjacent rough surfaces prior to lacquering. In order

to prepare these parts for lacquering and thoroughly remove tripoli placed on the rough surfaces during polishing, Mr. Schindler explained, a motor-driven pump, flexible hose and nozzles are used to spray clean solvent on the work at a pressure of approximately 35 pounds per square inch. Cleaning by slushing is accomplished by merely lowering the work into the vapor area, spraying it with solvent, allowing the work to be heated and dried by the vapors, and removing it from the machine.

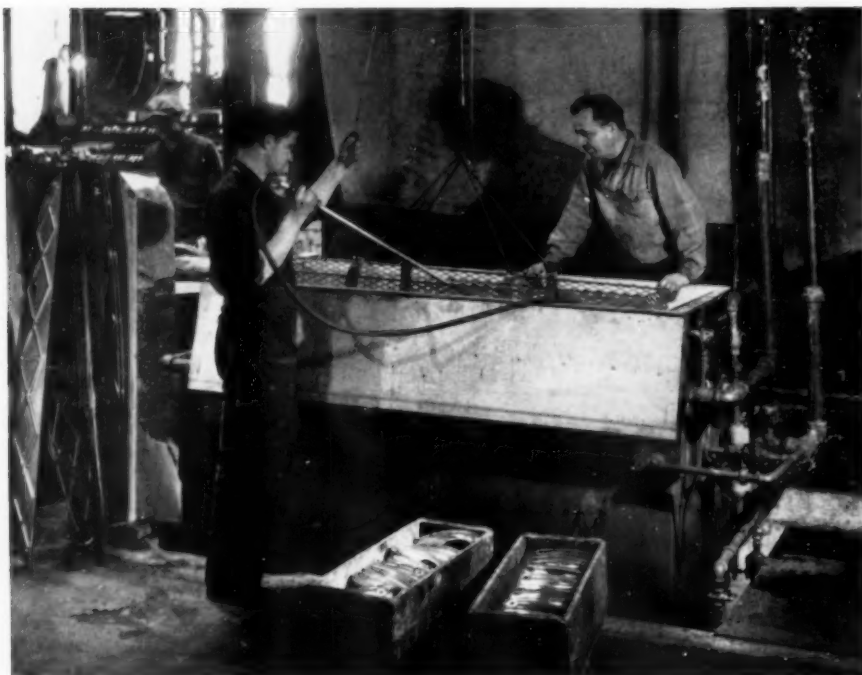
Another specially engineered solvent degreasing machine, electrically heated and having a number of new features, was recently installed in the plant of the Thermador Electrical Manufacturing Co., 5119 Riverside Drive, Los Angeles. This unit is being used to clean a wide variety of products in the new plant of this company. The firm manufactures electrically heated products which include ranges, water heaters, bathroom heaters, stoves, and various types of forced draft heating units, as well as



New two-dip, gas-heated degreasing unit recently installed in the plating room of the Weiser Manufacturing Co., Southgate, Calif. Also shown are brass door knobs, handles and lock parts and other units of builders' hardware handled in the Weiser plating department. Inspecting the new machine, left to right, are M. M. Cahoe, plating shop foreman; Bruno H. Schindler, plant superintendent; and Frank T. Barker, company president.



Showing electric hoist lowering basket of small forced-draft heaters into new degreaser recently installed in the plating department of the Thermador Electrical Mfg. Co., 5119 Riverside Dr., Los Angeles. This massive unit, with the greater portion of its auxiliary equipment housed in a six foot pit immediately below the operator, accommodates sheet metal partitions as large as 84 by 48 inches, and smaller parts in baskets (as shown here) 30 by 30 by 18 inches in size.



Spray-type, gas-heated, manually operated degreaser newly installed in the plant of the United States Spring and Bumper Co., Vernon, Calif., for cleaning bumper guards. William Shiltz (L) is plating shop foreman; and Alexander Regmunt (R), head plater.

sheet metal cases and cabinets and large sheet metal partitions. The new degreasing machine is a combination unit, capable of degreasing the company's entire line of products. Work is loaded into the degreaser by means of an electric hoist which travels on a boom and makes it possible to carry the work through pre-determined cycles in the machine and then transfer it to the desired location in the cleaning department. The degreaser is so designed that large water heater jackets up to 36 inches in diameter and sheet metal partitions in sizes as large as 84 by 48 inches can be degreased and cleaned, prior to painting, in a large vapor chamber. In addition to the vapor section, two liquid chambers capable of handling large quantities of small parts in baskets 30 inches by 30 inches by 18 inches deep are provided below the vapor cleaning area. Practically the entire production work of the Thermador Company receives some type of painted or enameled finish after degreasing.

Immersion type electric units are utilized in this installation to provide the necessary heat in one of the two immersion chambers. The heating equipment consists of two banks of elements, one with three 3,000-watt heaters, and another with three 4,000-watt heaters. Switches are so ar-

ranged as to provide three different heats, making it possible to use nine, twelve or twenty-one kilowatts at any given time. Low heats are used for cleaning large, bulky loads having light weight factors, while full heat is required during the cleaning of large heavy loads of material.

The degreasing machine is capable of cleaning one ton of work per hour. A cooling tower and circulating system provide a continuous flow of water to the jacket-type condenser. The

machine has an over-all height of over nine feet. Auxiliary equipment, such as storage tank, moisture separator, transfer pump and piping are below floor level in a pit six feet deep. The unit extends above the floor level to a height of approximately three feet to give the proper elevation for convenient and safe work.

A spray type degreaser has also been added to the equipment at the plant of the United States Spring and Bumper Co., Vernon, Calif., for work on bumper guards and spring parts. The gas-heated unit is manually operated, and has a chamber 5½ ft. long, 2 wide and 2 deep. Work is placed in a mesh basket and loaded and unloaded by means of an air-operated hoist. Sheet-metal gravel deflectors of the type now being used extensively in automobile production are cleaned in this machine prior to enameling. Loads up to 150 pounds of these parts are placed in the mesh baskets, lowered into the vapor area, and sprayed with clean warm solvent at a pressure of approximately 35 pounds in order to remove oil, shop dirt, and loose oxides. The work is then allowed to be heated and dried by the vapor and is removed from the machine ready for the enameling operation.

William Shiltz is shop foreman, and Alexander Regmunt is head plater at the United States Spring and Bumper Co. In addition to gravel deflectors, Foreman Shiltz declared, a considerable production of bumper guards is cleaned prior to plating in a bright nickel solution.

Agateen LACQUERS

All types
of
Clear
Lacquer
for Metals

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Agate Lacquer Mfg. Co., Inc.
11-13 Forty-third Road, LONG ISLAND CITY, N. Y.

Agateen —The Last Word in Quality

Air Filters for Organic Finishing

The organic finishing of products usually involves two operations: (1) applying of the finishing material, and (2) drying of the finishing material, each operation presenting its own specific problems.

Lacquer, unlike paint, enamel and other slower drying finishes, usually requires no drying operation, but its application often presents a much greater problem due to the unusual properties of this type of finish. Air filters offer a simple and practical solution to many of the problems of product finishing. They are used in spray booths to control surplus spray, in compressed air lines to remove entrained oil, moisture and dirt, and in finishing rooms, drying rooms and baking ovens to eliminate dust and dirt.

When products are finished by spraying, the work is usually done in special booths equipped with exhaust fans to carry the fumes and spray vapor outside the building.

Spray vapor, because of its nature and volume, creates several serious maintenance problems — the three most important of which are:

1. Reduced fan efficiency—due to accumulation on fan blades.
2. Fire hazard—resulting from deposits in exhaust dust.
3. Unsightly appearance — caused by settling on outside walls.

A special air filter developed for spray booth service eliminates the spray vapor by removing it from the exhaust air before it reaches the fan and ducts. Formerly standard ventilation units equipped with special louvres were used for paint spray removal, but their relatively low capacities together with the extra expense of the louvres made their cost almost prohibitive except where conditions were unusually bad.

A large capacity of sinuous spray booth filter with a capacity of 1500 cu. ft. per minute is available. Air filters are installed so that all air passes through them before reaching the fan and exhaust ducts. It is ad-

visable to incline the filter forward 5 to 10 degrees to prevent drops of spray collecting on the back edge of the baffles which might be carried off in the air stream.

The sinuous spray booth filter consists of a cell and frame. The frame is fastened permanently to a sheet metal partition at the back of the booth. The cells fit into the frames and are held in place by spring latches. Each cell has a capacity of 1500 C.F.M., and the number required for any spray booth is determined by the capacity of the fan—use one filter for fan capacities up to 1500 C.F.M., two filters for 1500 C.F.M. to 3000 C.F.M., three filters for 300 C.F.M. to 4500 C.F.M., etc.

When filters are installed in a spray booth, the amount of air exhausted may be reduced from 5% to 10% due to the resistance of the filters, if the fan is operating at or near its maximum rated capacity.

It is advisable, therefore, to speed up the fan proportionately if the spray vapor is not exhausted as quickly as before the filters were installed.

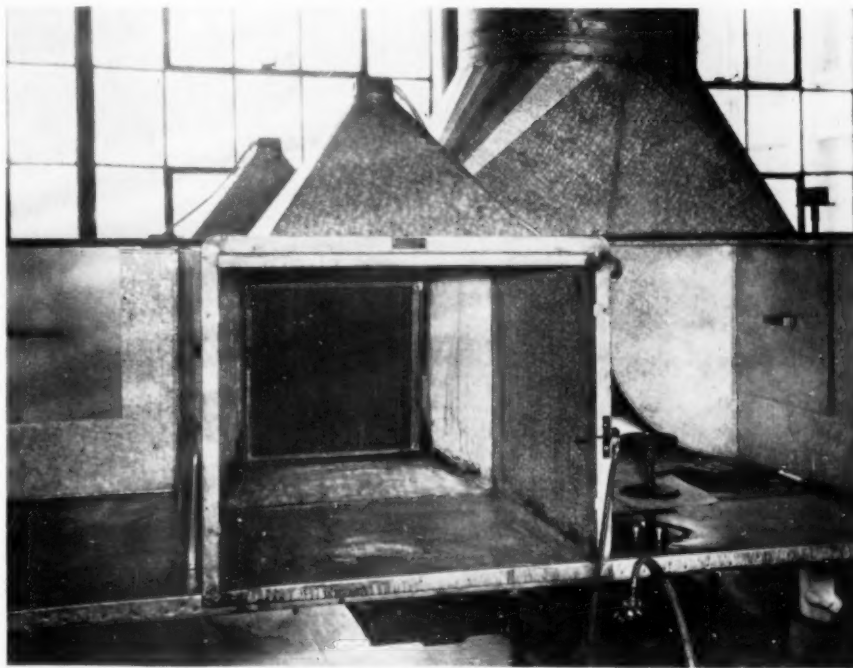
The air velocity at the front or open side of the booth should not be less than 85 nor more than 100 ft. per minute to secure best results.

Performance Data

Following are the results of a test made under actual operating conditions in a spray booth equipped with sinuous spray booth filters.

Two types of finishes were used in about equal amounts—dark green air-drying enamel, which weighed 2 pounds, 5 ounces per quart, and black oil-proof lacquer weighing 1 pound, 4 ounces per quart—making the average weight of the spray trapped by the filter, 1¾ pounds per quart.

At regular intervals, the filter cell was removed and weighed to determine the amount of paint spray accumulated, and the air velocity through the filter was checked with a pitot tube. Note that the original capacity of the filter was 1730 C.F.M., an increase of 230 C.F.M. over its normal rated capacity. This 15% overload was added to approximate the most adverse operating conditions.



Air filter installed in a finishing spray booth.

Days of Operation	Wgt. of Paint Spray Accumulated	Air Velocity	Capacity in C.F.M.
0	0	630	1730
5	1 lb. 6 oz.	600	1620
10	1 lb. 10 oz.	570	1570
15	3 lb. 13 oz.	550	1510
20	5 lb. 0 oz.	520	1430
25	5 lb. 13 oz.	415	1140
30	6 lb. 3 oz.	156	430

The reduction in capacity was gradual and uniform until the filter had accumulated 5 pounds of paint spray, at which point it began to fall off rapidly. The frequency of cleaning a spray booth filter, therefore, may be determined by the time required for one filter cell to accumulate five pounds of the material being sprayed.

Efficiency

White test plates, which were placed immediately behind the filter and remained there throughout the test period, showed no evidence of paint spray deposits.

The guaranteed efficiency of the sinuous spray booth filter is 97%. The 3% which escapes is made up of tiny particles, so small that they are practically of no consequence.

Recommended Cleaning Method

The proper method for cleaning the sinuous spray booth filter depends upon the type of material being sprayed. Lacquer, because of its quick drying properties, is practically a dry dust by the time it reaches the filter. This makes it necessary to use a viscous coating on the filter with lacquer finishes. Viscosine B (filter oil) is recommended for this service. The filter is cleaned by immersing it in a tank of hot water to which a cleaning compound or detergent has been added (1½ lbs. to 20 gals. of water). After the filter is washed clean, it is dipped in Viscosine, allowed to drain for twelve hours or more, and then put back into service.

Paints, varnishes, enamels and other slow drying finishes reach the filter as a liquid spray. No viscous coating is required—the filter should be used dry. With these finishes the filter is cleaned by boiling in a caustic solution (10° to 15° Baume hydrometer) in what is commonly called a "stripping tank," usually found in plants where metal parts are finished.

Reclamation

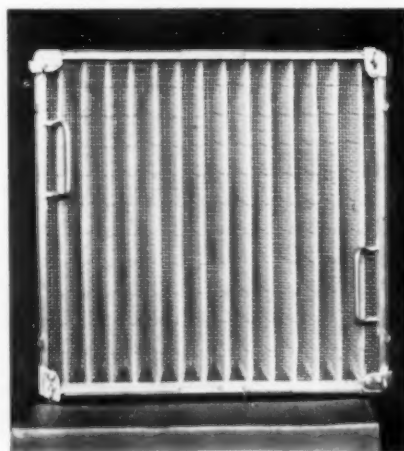
While it is possible to reclaim paint spray from the filters by using the proper solvent, it will prove economical in very few cases. Where it is practical, however, reclamation presents another reason for the use of sinuous paint spray filters, in addition to eliminating the nuisance and the bother of surplus spray.



Group of spray booths, each equipped with sinuous spray booth filters.



Multi-panel automatic air filter.



Airmat type filter.

Clean Air for Finishing Rooms

If a number of booths are required to handle the volume of production, the large quantity of air exhausted from the finishing room creates a heating problem during the winter months and a dust problem throughout the year. While the air exhausted from a spray booth equipped with a filter is clean enough to breathe, being freer from dust and dirt than ordinary outside air, the solvent fumes that it carries eliminates any possibility of returning it into the workroom. Until some practical method for removing fumes has been developed, it will not be feasible to recirculate the air exhausted by spray booths.

Additional heated air must, therefore, be introduced to make up for that which is continuously being exhausted from the finishing room.

A simple solution to both the heating and the dust problems is a fresh air supply system consisting of a fan, heating coil and an air filter of the proper size and type. Some types of unit heaters are practical for this service if equipped with air filters and provision is made for them to take air from outside the finishing room. The ventilation system of a typical finishing room has the inlet damper adjustable, making it possible to take air from outside or some other part of the building in any proportion desired.

The capacity of the supply system should be equal to the combined capacities of the exhaust fans in the spray booths, plus ¼ the cubical volume of the finishing room. In this way, a positive pressure will be maintained in the room and any leakage will be outward through cracks or openings. All the air inside the finishing room will be filtered—and when a door is opened clean air will flow out, preventing the entrance of dust and dirt.

Example: a finishing room 30 ft. wide, 50 ft. long and 12 ft. high contains two spray booths, each exhausting 2100 cu. ft. of air per minute—what capacity ventilating system is required? ¼ of (30×50×12)=18,000 cu. ft.) is 4500 plus 4800=9300 C.F.M.

Acknowledgment—For illustrations and information given in the above article, we wish to thank American Air Filter Co., Inc., Louisville, Ky.

ORGANIC FINISHING DIGEST

PATENT AND LITERATURE REVIEWS

Potentiometric Examination of Anticorrosion Pigments. M. E. D. Jarrett. J. Oil Colour Chem. Assoc. 23, 49-5 (1940). An important factor in the corrosion of metal is its potential towards the solution with which it is in contact. The more negative the potential of the metal is, the greater its tendency to corrode. The writer painted steel strips with various pigments suspended in linseed oil, then determined the potential of the steel under differing conditions. He let the paint dry out for two days then determined the potential of the steel suspended in tap water in relation to the time of suspension. By means of these measurements the writer determined the difference between pigments giving only protection by coverage and pigments that give electrochemical protection. Different pigments can also be recognized by means of these tests.

Color Matching at the Forbes Varnish Company. R. F. Wysocki and A. K. Gaetjens. Illum. Eng. 35, 343-50 (1940). A description of the means and methods for the color matching of varnishes used at this particular plant from the illumination engineering standpoint.

Drying Oil Situation in America. H. A. Gardner. News, Ed. (Am. Chem. Soc.) 18, 358 (1949). The unsettled conditions in the far east have resulted in the dislocation of the supply of tung oil which normally contributes about 20% of the oils used in the paint and varnish industry. The writer suggests the use of newer and synthetic drying oils to supplant tung oil.

Determination of Driers in Varnishes. M. E. D. Jarrett. J. Oil Colour Chem. Assoc. 23, 29-33 (1949). The author gives and describes rapid colorimetric methods for the determination of lead, cobalt, and manganese in varnishes.

"Vinylite" Resins for Can and Container Coatings. A. K. Doolittle. News Ed. (Am. Chem. Soc.) 18, 303-5 (1940). Vinylite resin (VYHF) containing about 87% vinyl chloride and 13% vinyl acetate is the simplest type of surface coating. A description of its uses and possibilities in lining containers, etc., is given by the writer.

Metal Finishing. W. F. Sherman. Iron Age 146, 84, 32 (1940). A comprehensive discussion of the methods employed by modern industry in the process of metal finishing. The writer outlines and describes the practice in modern metal finishing at the Allis Chalmers Company plant in Pittsburgh. This is a "typical" modern installa-

tion. He gives a complete description of the cycle of events employed in finishing transformer housings or casings. The cycle runs as follows:

1. Alkali wash.
2. Hot Rinse.
3. Rust proofing.
4. Cold rinse.
5. Chromic acid bath.
6. Blow off to remove excess water.
7. Oven drying.
8. Spraying on prime coat.
9. Baking.
10. Second coat and final baking.

Matching Porcelain Enamels. F. H. Emery. Steel, 106, 48, 50 (1949). A description of methods for matching porcelain enamels.

Production of Refined Linseed Oil. I. T. Osnos, I. I. Golovistikov, K. I. Orlova. Khim. Referat. Zhur. 7, 112 (1939). A method for the production of refined linseed oil was developed and improved. The linseed oil was treated with a 0.25-0.50% hydrochloric acid solution with rapid and vigorous mixing and heating. 15 minutes at 30-40° centigrade 0.15-25 minutes at 40-60° centigrade finally permitting it to settle for 2-3 minutes at 50-60°C. The mix is neutralized with 13-14% sodium hydroxide, 5-50% excess being added. Now the mix is washed and dried in vacuo. In this way 75-90% of the glutenous substances present in raw linseed oil are removed.

Varnish Observation. M. Hess. Paint Mfr. 10, 111 (1940). The writer gives a simple method for the daily plant control of varnishes.

Varnish Losses in Weight and Volume. Natl. Paint, Varnish Lacquer Assoc. Sci. Sect. Oct. (1939). The results of a series of tests on ten different resins and two different drying oils with regard to weight and volume losses, are given.

Enameling on Bronze, Gilding Metals, Silver, Silver Deposits and Gold. W. E. Charles. Chem. Age. (lond) 42, 214, (1940). An abstract on the subject.

Baking and Drying. J. E. Daree. Steel, 105, 59 (1939). A description of gas fired baking and drying ovens illustrated with diagrams.

Influence of Resins on the Heat Bodying of Oils. R. C. Shuey. Ind. and Eng. Chem. 32, 921-930 (1940). The course of change during the heat bodying of oils is markedly

influenced by the presence of resins during the heating. The resins exert specific effects outside of simple dilution and these effects are manifested in the application and service of the resulting varnish. The writer proposes a method for classifying resins by the comparison of their influences on the bodying of tung oil and the properties common to the major groups are compared. (1) Heat hardenable resins may so exceed the oil in polymerization rate that the utilizeable consistency may be passed, before the oil component has attained any appreciable degree of polymerization. (2) Non heat hardenable resins, if of the class which accelerates polymerization of tung oil at all concentrations are proportionately better for cooking with the slower oils which normally receive high temperature treatment. In general, the greater the acceleration, the quicker the drying produced. This class of resins produces varnishes of the highest durability. (3) Resins which exert normal or more than normal dilution retardation should not be cooked with the oils but added after the heat treatment has been effected. Resins seldom if ever form true solutions in the oils and colloidal effects often overshadow the more hidden chemical effects which are important in the improvement of serviceability, the prime purpose of heat treatment.

Drying Oils and Resins. T. F. Bradley, D. Richardson. Ind. and Eng. Chem. 32, 963-69 (1940). Ultra violet absorption methods have been applied to a series of samples prepared in the course of a fundamental study of polymerization of some drying oils. Partial interpretation of the absorption curves has been accomplished through the studies of analogous and related compounds. It shows that absorption spectra can be particularly useful in cases where conjugated double bonds are concerned. Some evidence can be deduced with regard to the presence of cyclic or aromatic molecules in a given sample. The distillation of the heat polymerized methyl esters of the acids from a drying oil yields residues which absorb ultra violet light more strongly than the monomeric distillates. This increased absorption is evidence of either increased saturation or increased molecular complexity of these products. The decreased iodine numbers and other chemical evidence, makes the ring formation the most acceptable explanation. Numerous charts and diagrams are given.

Magnesium Alloys. Am. Mach. 84, 30-2 (1940). A discussion of the surface treatment of magnesium alloys for painting purposes.

Solvents in Industry

Methyl Ethyl Ketone

(2-butanone, ethyl methyl ketone, butanone)

Physical Properties

Methyl ethyl ketone is a colorless and stable organic liquid having the chemical formula $\text{CH}_3\text{COC}_2\text{H}_5$ and a molecular weight of 72.10. It is the next higher homologue of acetone (dimethyl ketone, CH_3COCH_3) and possesses a typical ketonic odor which, however, is somewhat less pronounced than that of acetone.

With the usual organic solvents, methyl ethyl ketone is miscible in all proportions. However, the miscibility of methyl ethyl ketone with water is not complete, as is acetone. At room temperature it is soluble in water to 27.5% and water is soluble in it to 12.5%. At 90.0% by volume concentration with water, methyl ethyl ketone forms a constant boiling mixture which boils at approximately 73° C. It also forms azeotropes* with other organic solvents including ethyl alcohol, ethyl acetate, benzene, isopropyl alcohol and tertiary butyl alcohol.

Methyl ethyl ketone is a good solvent for nitrocellulose; for amberol-, glyptal- and vinyl- type resins; for kauri, cumar, cumarone and copal gums; for camphor and rosin. Elemi, bleached shellac and certain of the dammars are only partially soluble in methyl ethyl ketone. Low viscosity cellulose acetate will dissolve in methyl ethyl ketone but high viscosity cellulose acetate will not.

The vapor pressure of methyl ethyl ketone, expressed as mm. of mercury, varies from 34.3 at 0° C. to 114.3 at 30° C. At room temperature it is approximately 70 mm. Its rate of evaporation, referred to normal butyl acetate as 1.00, is 4.6. The Tag closed cup flash point is approximately 25° F. and the upper and lower explosive limits of its vapor are, respectively, 10.2% and 1.97% methyl ethyl ketone.

The density of pure methyl ethyl ketone at 20° C., referred to water at the same temperature, is 0.806 (6.72 pounds per gallon at 20° C., approximately the same as normal butyl alcohol). Its boiling point at 760 mm. mercury pressure is 79.6° C. and its freezing point is -86.4° C. Other physical constants of methyl ethyl ketone are:

Specific Heat (liquid) 0.55 cal./gm. (20°-78° C.)
Latent Heat of Vaporization 106.0 cal./gm. (20° C.)
Coefficient of Expansion 0.00076 per °F. (60°-125°)
Vapor Density 35.14 (H=1.00)

Chemical Properties

Because of its molecular structure methyl ethyl ketone enters into a number of chemical reactions to produce many interesting and important compounds. It may be reduced to secondary butyl alcohol and oxidized to acetyl, a valuable flavoring ingredient. It condenses with both aromatic and aliphatic compounds, may be chlorinated and brominated and, under certain conditions, may be made to form higher alcohols, hydroxy esters, terpenes, resins, acetic acid, etc.

Physiological Properties

The recorded data on the physiological effects of methyl ethyl ketone on man are not extensive, although some studies have been made in connection with its toxicity to animals. Like many organic solvents, methyl ethyl ketone possesses the ability to remove the natural oils from the skin, thus possibly paving the way for dermatitis. It has a distinct odor and fair warning properties in that eye and nose irritations result from concentrations which are known to be not particularly toxic to guinea pigs. Flammable mixtures of air and the vapor of methyl ethyl ketone are very irritating to the eyes and nose. Although methyl ethyl ketone does not appear to be an especially toxic substance, precautions such as proper ventilation of rooms in which it is being used, etc. should be taken, as with all organic solvents.

Specifications

The following are data on one grade of commercially available methyl ethyl ketone.	
Purity	Not less than 99% methyl ethyl ketone by weight.
Specific Gravity (20°/20° C.)	0.805 - 0.807
Color	Not over 10 platinum cobalt (Hazen) standard.
Water	Miscible without turbidity with 19 volumes of 60° Baume gasoline at 20° C.
Acidity	Not more than 0.003% calculated as acetic acid.
Distillation Range	
(A.S.T.M. Specification D 268/33)	Below 79° C. None
	Above 80.5° C. None
Non-Volatile Matter	Not more than 3 mg. per 100 ml.
Weight	6.72 lbs. per gal. at 20° C. (approx.)

*Liquids, which when mixed in specific quantities and form constant boiling mixtures, are said to be azeotropes. The distillates from such boiling mixtures have the same composition as the original mixtures. The boiling point of an azeotropic mixture is lower than that of either of the constituents and the vapor pressure is higher. Some azeotropes of methyl ethyl ketone, in parts by weight, are:

The industrial uses of methyl ethyl ketone have been limited until very recently when the synthetic product appeared on the market. Previously, it was available only as a by-product of the distillation of wood and then only in small quantities of questionable uniformity. However the new synthetic methyl ethyl ketone is being produced in commercial quantities and because of its high quality and dependable properties, is finding an increasing number of industrial consumers.

One of the largest uses of methyl ethyl ketone is in organic finishing materials, where its excellent nitrocellulose and resin solvency, its stability, low specific gravity, etc. make it very useful as a solvent.

In addition to its use in organic finishing materials, methyl ethyl ketone finds application as an ingredient in paint and varnish removers and, with water, clay and phosphoric acid, in metal cleaning compounds. A patented process for the dewaxing of lubricating oils employs a mixture of benzene and methyl ethyl ketone, the benzene acting as the wax solvent and the methyl ethyl ketone as the wax precipitant. Lubricating oils are also freed from sulphur with methyl ethyl ketone and alkali sulphides.

In the dyeing industry, methyl ethyl ketone is used in the cleaning of fabric preparatory to dyeing and as a solvent for certain dyes. It has been used in a number of chemical processes and analyses and as an extractant for many substances. It has also been suggested for use in the preparation of anhydrous soaps and as an ingredient of fungicides, bactericides and insecticides.

Methyl ethyl ketone is used as a solvent in printing and lithographing processes and in the manufacture of molded plastics and artificial leather.

First Component	Pts. by Wt.	Second Component	Pts. by Wt.
Methyl ethyl ketone	37.5	Benzene	62.5
"	34.0	Carbon disulfide	66.0
"	29.0	Carbon tetrachloride	71.0
"	40.0	Ethyl alcohol	60.0
"	26.0	Isoamyl formate	74.0
"	30.0	Isopropyl alcohol	70.0
"	86.0	Methyl alcohol	14.0
"	52.0	Methyl propionate	48.0
"	55.0	Propyl formate	45.0
"	88.6	Water	11.4

NEW EQUIPMENT AND SUPPLIES

LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Baked Enamel Stripper

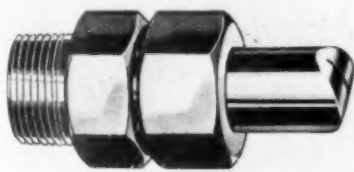
The Enthone Company, New Haven, Conn., have announced the development of a new stripper for removing baked enamels, in addition to their regular stripper.

This new material, called "Stripper P," is said to have powerful stripping action on all types of synthetic baked enamels, such as urea formaldehyde, glyptal, resyl, bakelite and other types. It is also recommended for removing air dry enamels, japans and lacquers. The stripper dilutes with water to form a clear solution or dispersion, which does not layer and is stated to be free rinsing. Normal dilutions range from 1 part stripper to from 3 to 8 parts water, and the solutions are operated from room temperature to 200° F.

The stripper is reported to be non-corroding to all metals, including aluminum, zinc, magnesium and copper alloys.

Air Nozzles

The illustration shows an air nozzle just placed on the market. Spray is flat with uniform distribution. Nozzles are available in $\frac{1}{4}$ " and $\frac{3}{8}$ " male or female pipe connection. Capacities range from two to seven C.F.M. of free air at 50 pounds pressure. Strainer is optional. Standard stock construction is brass with monel metal strainer. Other materials can be specified.



Nozzle giving flat, uniform air spray.

Recommended for drying after washing in metal cleaning; chemical processes;—to be used wherever a flat, wide stream of air with uniform distribution is required.

Made by Spraying Systems Co., 4019-21 W. Lake St., Chicago, Illinois.

Clear Coating Material

A new coating material, known as Microlac, to be used to protect and beautify metal surfaces of either natural or plated finishes, has been introduced by the Michigan Chrome Company, 6348 East Jefferson Avenue, Detroit, Mich.

One of the outstanding characteristics claimed for this new material is its color, which approximates that of distilled water. In addition, it dries to a high lustre, and is

said to offer excellent qualities of adhesion, flexibility and abrasion resistance. It dries exceptionally fast—the type of coat applied for ordinary decorative work drying in only a few seconds' time.

Microlac is claimed to provide excellent resistance to sulphur dioxide, sunlight, moisture (preventing rust), oil, grease, gasoline, and all commonly known chemical fumes. It does not blush even in the most humid weather.

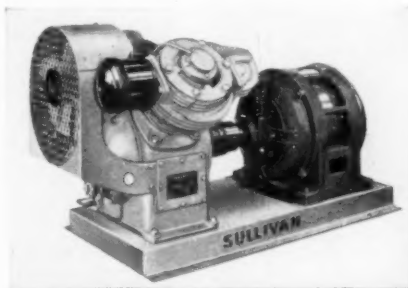
A unique feature of this material is that it is not to be mixed with thinner as has been the usual practice with similar lacquers. It is used exactly as it comes out of the container. It is accurately adjusted for viscosity and total solids to insure absolutely uniform results. This eliminates all possible chance of contamination during the mixing operation, and does away with the guesswork and extra labor usually involved in adding thinner to the lacquer.

Microlac is furnished in one-gallon and five-gallon cans and fifty-gallon drums. It is applied by spraying or dipping. If desired, it can be brushed on small parts. Among its many applications are: silver plated ornaments, trophies, etc., . . . polished brass or brass plated light fixtures, interior and exterior hardware and similar products . . . automobile hardware . . . copper, aluminum, wrought iron or stainless steel surfaces. It is an excellent material for protecting the finish on exposed metal surfaces of scientific instruments. It can be used on all types of metal mouldings.

New Small Compressor

A new small Stationary Compressor of precision design is being offered by Sullivan Machinery Company, suitable for small industries and for standby service. It is compact, light weight and smooth running, requiring little floor space and minimum power.

This WL-70 is a two cylinder, single stage



Small stationary compressor.

compressor with complete air cooling—built-in aftercooler—force feed lubrication—heavy duty ball main bearings—low lift, long life valves—air filter silencers on each cylinder—automatic regulation—easy accessibility for inspection.

There are five sizes: 96 to 233 C.F.M. displacement, 15 to 30 H.P., air pressures 30 to 125 lbs. The smallest size is only 2 ft. 5 in. long—2 ft. 9 in. wide—2 ft. 4 in. high. These WL-70 Unitairs are supplied as complete motor driven units on rigid steel sub-base, direct connected or V-belt driven; also less sub-base with V-belt sheave or flat belt pulley.

Bulletin A-34 of Sullivan Machinery Company, Woodland Avenue, Michigan City, Indiana describes this compressor.

Perspiration Resistant Lacquer

A new type of clear lacquer that is especially suitable for finishing articles frequently handled, such as flashlamps, pencils, compacts, lipsticks, etc., is announced by Maas & Waldstein Co., makers of industrial finishes, Newark, N. J.

This new lacquer has been specially developed to resist the corrosive action of perspiration, and furnishes excellent protection for both finished metal surfaces and undercoats of lacquer enamel. It is light in color and has good outside weather resistance, adhesion, and color retention. It is furnished in either high gloss or flat finish.

Manufacturers' Literature

Air-Motored Agitators. In a new 32-page catalog, the Eclipse Air Brush Co., Inc., 398 Park Ave., Newark, N. J., describe their complete line of spray equipment for both manual and automatic operation. Included is a section devoted to their "Pneumix" air-motored agitators. Sent upon request.

Cabinet Ovens. George Koch Sons, Inc., Evansville, Ind., in an 8-page folder, describe and illustrate cabinet ovens available for the organic finishing industry. Features of the ovens include standard sizes with lower production costs, recirculating system, thermostatic control and pilot light signal. Special equipment for the ovens used is also described.

Chlorinated Rubber. Hercules Powder Co., Wilmington, Del., have recently issued a valuable little booklet describing their chlorinated rubber. The booklet is printed in catechism style and answers many questions pertaining to chlorinated rubber and chlorinated rubber finishes.

Chrome Aluminum Finish. Edward C. Ballou Co., 6 Varick St., New York City, have available literature with a sample of their chrome aluminum imitation finish which is said to give a beautiful imitation of a real metallic finish. The product is manufactured in paste form and for maximum brilliance should be used in connection with quick-bake synthetics or varnish-type vehicles. It can also be mixed with lacquers with some sacrifice of brilliancy.

Control Instruments. In a recently revised bulletin, the Bristol Co., Waterbury, Conn., present a complete line of modern thermometer and pyrometer controllers—for gas, electric and oil-fired industrial furnaces and ovens. Also included is information regarding the various air and electrically operated controllers available—automatic control valves, thermometer bulbs and thermocouples. Copy may be obtained upon request.

Enamels. Hercules Powder Co., Wilmington, Del., describe "Parlon" fortified enamels in a new 6-page folder. Parlon is the trade name of chlorinated rubber as manufactured by Hercules Powder Co. Features of chlorinated rubber enamels, such as drying time, alkali resistance, wear resistance, rapid drying, etc., are described.

Heat Controls. Burling Instrument Co., 241 Springfield Ave., Newark, N. J., describe and illustrate their heat controllers in a recently issued 4-page folder. These controllers are available for heating from as low as 100° F. and as high as 1400° F. Recommended for baking and annealing ovens, metal pots, high pressure steam lines, super-heaters, etc.

Heat Reflectors. Dayton Mfg. Co., Dayton, Ohio, describe and illustrate their reflectors for concentrated infra-red ray radiant energy drying. The reflectors have polished gold surfaces and an adjustable focus. Advantages in the use of radiant heat for drying organic finishes are outlined.

Industrial Ovens. Kirk & Blum Mfg. Co., Cincinnati, Ohio, in a 22-page catalog, profusely illustrated, describe ovens for enameling, drying and baking. Ovens arranged for automatic dipping or in spraying of finishes, are described by diagrams and illustrations.

Pressure Cleaning. Homestead Valve Mfg. Co., Hypressure Jenny Div., Coraopolis, Pa., in a four-page folder describe and illustrate uses for their Hypressure Jenny portable spray cleaning equipment.

W. Leslie Lawrence was recently elected secretary of the Alexander Milburn Company.

Mr. Lawrence filled various positions with

the company, first as Baltimore representative, then on National Sales, and a short time ago became one of the company's directors. He is well acquainted in both the oxy-acetylene and paint spray fields.

Mr. Lawrence succeeds Harvey H. Johnson, who passed away on June 2 after serving the company for 25 years.

Training School for Spray Painting

The DeVilbiss Company announces the schedule of their training school for the last half of 1940. To be held in the Company's Toledo plant, the school is open to industrial painters, master painters, automobile refinishers and all others interested in learning the technique of spray-painting and the use and care of spray-painting equipment.

Each training period lasts for one week. The first class opens July 15th. Others begin on the following dates: August 26th, September 23rd, October 21st and December 29th.

Special rates in Toledo hotels and boarding-houses near the plant have been secured by the Company for men attending the school.

These classes have been well attended in the past because of the facilities for study otherwise unobtainable, offered by the DeVilbiss Laboratories.

It is advisable to enroll in the school as far in advance as possible, since the size of the classes must be limited, and since there will be no training period other than those announced.

Complete information may be obtained by writing The DeVilbiss Company, Toledo, Ohio.

American Asphalt Paint Co., 43 East Ohio St., Chicago, manufacturers of the VALDURA line of heavy-duty paints and coatings are now installing in their Kankakee, Illinois, plant the second 300 H. P. Diesel unit within a year. The engine is directly connected to a 200 kilowatt alternating current generator.

Other new equipment recently installed includes three latest designed ball mills and

two additional high speed roll mills.

With the addition of this and other equipment the production capacity of the Kankakee plant has been doubled during the past year.

New Film Tells Importance of Chemical Coatings

How chemical coatings are vital considerations in modern industry and how they are important to everyday living is explained in the new all-color, sound movie, "More Than Meets the Eye," released this month by Interchemical Corporation, New York City.

Chemical coatings—inks, industrial finishes and enamels, textile colors, and other protective and decorative materials—are shown in this film to be important sales influences. It is pointed out that performance today is often taken for granted in a product. But the appearance of the article can "make or break" a sale, whether the product be a refrigerator, a household appliance, a magazine, a printed shirt, or a dress fabric.

In many cases, the chemical coating may be important as adding to the life of the product. For example, when a woman buys a dress her first thought is usually "How does it look?" Then if she likes the pattern, she will want to know whether the colors will be fast to sunlight and whether they will remain bright after repeated washings.

"More Than Meets the Eye" describes the processes and research back of the manufacture of these coating materials and shows how the requirements of the ultimate consumer must be taken into account in the manufacturing operations. The enamel finish for a washing machine, for example, must produce a surface so tough that it will resist the chipping and marring and the various deteriorating forces to which the product will be subjected in the user's laundry.

The functions of the various divisions and subsidiaries of Interchemical are outlined in the picture. These units are engaged in



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ENTHONE
BAKED ENAMEL STRIPPERS
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Most powerful stripper available for quickly removing baked enamels of the urea-formaldehyde, resyl, glyptal, glycerolphthalic and bakelite types—**ECONOMICAL!** Stripper "P" is used with up to 8 parts of water, forming stable solutions which do not layer. Non-caustic, does not etch or attack any metal. Strips rapidly—rinses freely!

Write today for a sample and information for cutting your enamel stripping costs.

The ENTHONE Co.
NEW HAVEN, CONN.

 **Chemical Products**

producing printing inks, industrial finishes, textile colors, dry colors and pigments, press equipment, and various related products.

"More Than Meets the Eye" was produced by Willard Pictures, Inc., under the direction of George Welp, Interchemical Corporation.

The film has been prepared so that it will be of interest to manufacturers of products requiring chemical coatings and to the general public which uses these products. Since much of the picture is concerned with the production and application of industrial colors like printing inks, pigments, finishes, and textile colors, there are many spectacular color effects.

This movie is available for showings to manufacturers, associations, or groups interested in chemical coatings and their importance both in industry and in our daily living.

"Interesting" Heat Rays

July 12, 1940

Dr. W. R. Meyer, Editor
Metal Finishing,
New York City.

Dear Walter:

The July issue of Metal Finishing has been read with a good deal of interest, and you are to be congratulated on your excellent coverage of the Dayton convention.

May I call your attention, however, to page 416, column 3, paragraph 4, line 4, wherein the Dayton reflector for infra-red is purported to "project an even spread of interesting rays". They are not only interesting, Walter—they're fascinating!

Seriously though, the word should be "intersecting", and the characteristics of the intersecting rays are responsible for the tremendous success of this infra-red unit.

Cordially yours,

Eastern Equipment Co.,
Infra-Red Division
Harold P. Kneen

New York, N. Y.

Just a little error in proof reading, Harold.
—Ed.

Questions on Organic Finishing

Question. At various times we have been given advice on the prevention of blushing of the lacquers which we use. Some of the advice has been good and some more well intentioned than valuable. Will you please tell us the fundamental reasons for blushing and give the generally accepted methods for preventing it. We will appreciate this very much.

Answer. Blushing is caused by a separation of the constituents of a lacquer, particularly the nitrocellulose. This separation may result from the

use of improperly balanced solvents, but most usually occurs by the action of water taken up by the lacquer from the air. If the water is not present in the lacquer in large quantities, then it evaporates with the solvents and no difficulty is experienced. If, on the other hand, the air temperature and humidity is such that considerable water is available and can be taken up, blushing may result.

The following are measures to prevent blushing:

Warm all lacquers and thinners to room temperature before use. Prevent drafts by closing all doors and windows and, if necessary, by hanging draft curtains. Cold spray rooms

should be warmed. Use the recommended thinner and, if necessary, a lacquer retarder—a solvent which allows higher concentration of water in the lacquer and of such a nature that the water evaporates with it. Of course, we need not mention that the line supplying air to the spray guns should be kept free of condensed moisture.

It also should be pointed out that most blushing difficulties can be obviated by the use of finishing materials with good blush-resistant solvents.

In some cases where finished work shows blush after drying, it can be restored by spraying on a light coat of a mixture of lacquer thinner and retarder.

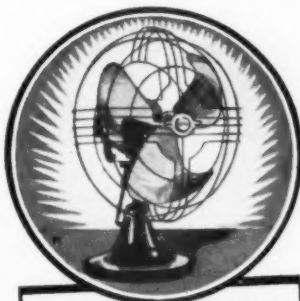
EGYPTIAN high-bake N.F.R.

**A tough, mar-proof,
chemically resistant synthetic finish
for all types of metal products . . .
Extremely durable. Increases resistance
to abrasion and other forms of wear**



WIDE RANGE OF BAKING TEMPERATURES

**SPECIAL UNDER COATS FOR ROUGH CASTINGS WHICH
AIR DRY FOR SANDING YET MAY BE BAKED AS A COMPOSITE
FINISH AFTER APPLICATION OF EGYPTIAN
high-bake N. F. R.**



**ONE COAT DIRECTLY ON SMOOTH METALS.
NO PRIMING COAT NECESSARY.**

Ask for further information

THE EGYPTIAN LACQUER MANUFACTURING CO.
ROCKEFELLER CENTER
NEW YORK



EGYPTIAN FINISHES

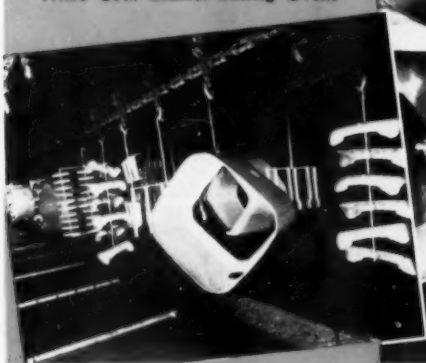
• In addition to High-Bake N.F.R. we also make a complete line of clear and pigmented lacquers for standard and individual requirements. These are furnished for spray dip or brush application . . . Air-dry and bake.

Ask for details

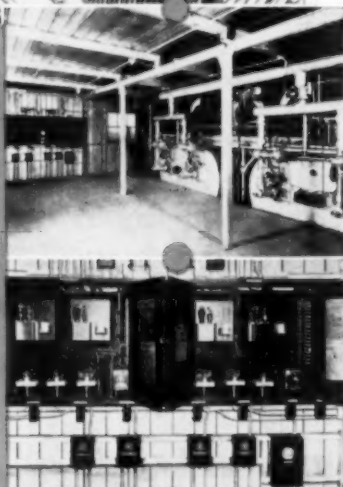
EGYPTIAN Superior FINISHES

Industrial FINISHING EQUIPMENT Keeps Pace with Modern Production Methods

Illustration at right shows Mahon Hydro-Filter Spray Booths in the Air Conditioned Spray Room at the Maytag Company's Plant, Newton, Iowa. Below: Parts passing through the Prime Coat Enamel Baking Oven.



Above: Complete Mahon Finishing System under construction on the roof of the Maytag Company's Plant, Newton, Iowa. Right: Oven Heating Equipment and inside view of all-steel enclosure which houses complete system. Right below: Automatic Temperature and Safety Control Panels which maintain proper temperatures throughout the entire system.



... Maytag Installation is Typical of Mahon's Thorough Engineering

The Complete Mahon Finishing System installed at the Maytag plant, Newton, Iowa, is an excellent example of up-to-the-minute finishing production planning . . . it is unique in that the entire system, with the exception of the Spray Booths, is located on the roof of the plant. All Metal Cleaning, Rinsing, Rust Proofing, Drying and Enamel Baking equipment is housed in an all-steel, firesafe enclosure on the roof, yet each operation in the finishing process is perfectly coordinated to produce the desired results with maximum efficiency and at the lowest possible cost . . . it is typical of Mahon's advanced engineering in this highly specialized field. Mahon engineers, backed by seventeen years of research and practical experience in every industry where finishing is a major production operation, are qualified to do a better engineering job on equipment of this type . . . you can turn your finishing problem over to them with complete confidence. Call in a Mahon engineer today—consultation and study of your requirements will not place you under any obligation.

THE R. C. MAHON COMPANY
DETROIT - - CHICAGO

Designers and Manufacturers of Complete Finishing Systems, Metal Cleaning Machines, Rust Proofing Machines, Hydro-Filter Spray Booths, Ovens of All Types, Filtered Air Supply Units, Hydro-Foam Dust Collectors and many other Units of Special Production Equipment.

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